# *Appendix A*

## FE/PWO Groundwater Extraction System Installation and Operation Plans

*Draft Final Report*

# Focused Extraction / Production Well Optimization System Installation

Prepared for

**Reynolds Metals Company**
**Troutdale Facility**

October 2006

Prepared by

CH2MHILL

**Printed on Recycled and Recyclable Paper**

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SECTION 1

# Introduction

This final report documents the installation of the focused extraction/production well optimization (FE/PWO) system at the Reynolds Metals Company Superfund site in Troutdale, Oregon, as designed. This final report also provides documentation demonstrating that the FE/PWO system is functioning as designed and is capable of meeting required performance criteria as specified in the *Unilateral Administrative Order for Remedial Design and Remedial Action* (Groundwater UAO) (EPA Docket No. CERCLA 10-2005-0217) (U.S. Environmental Protection Agency [EPA], August 2005). This documentation is provided consistent with the requirements identified in the following documents:

- *Memorandum WP No. 65: Work Plan for Focused Extraction System Design and Installation* (CH2M HILL, December 2004)
- Groundwater UAO
- *Memorandum WP No. 69: Focused Extraction and Production Well Optimization System Startup Performance Monitoring Plan* (CH2M HILL, November 2005)

Work was conducted in accordance with the *Record of Decision for Interim Remedial Action* (Interim ROD) (EPA, September 30, 2002). The Interim ROD identified the FE/PWO system as the "Selected Interim Action Remedy" for removing and containing high fluoride levels in groundwater in the east potliner and scrap yard areas and for minimizing the migration of contaminant groundwater in the south plant area. The FE/PWO system involves hydraulic containment through optimization of production well operation in the intermediate- and deep-zone groundwater and enhanced focused extraction of groundwater in the Upper Gray Sand (UGS) zone below the east potliner and scrap yard areas.

Remedial action objectives (RAOs) for site groundwater outlined in the Interim ROD included the following:

- Restore and maintain use of the intermediate and deep groundwater as a drinking water source. The goal of restoration is to meet the federal and state safe drinking water standards.
- Minimize the migration of contaminants from waste and soil to groundwater, reduce fluoride in shallow and intermediate groundwater, and control migration of contaminant plumes in groundwater.
- Control migration of fluoride to the Sandy River.

Site-specific remedial action goals identified for groundwater included the following:

- Onsite containment of south plant fluoride plumes with concentrations exceeding the maximum contaminant level (MCL), except for the area north of the U.S. Army Corps of Engineers dike.

- Statistically significant downward trend in fluoride concentrations in the UGS, intermediate, and deep zones over time.
- Reduction of total fluoride mass in shallow and intermediate zone groundwater.
- Achievement of National Pollutant Discharge Elimination System (NPDES) requirements for fluoride and other constituents of concern prior to discharge to the Columbia River.

The elements required under Section V, Task 3 in Attachment 2 (Scope of Work for RMC Superfund Site August 2005) of the Groundwater UAO are summarized in this final report. The Administrative Order on Consent (AOC) requires that the final report present a good-faith estimate of total costs; a description of the remedial action system and modifications; a description of remedial action performance and monitoring; and appendixes containing all relevant information.

This final report is organized into the following sections:

- Section 1: Introduction
- Section 2: FE/PWO System Installation
- Section 3: FE/PWO System Modifications
- Section 4: Performance Monitoring
- Section 5: Operations and Maintenance
- Section 6: Costs
- Section 7: Certification
- Appendixes

SECTION 2

# FE/PWO System Installation

The remedial action for restoration of groundwater at the Reynolds Metals Company (RMC) Superfund site relies on a combination of source control removal actions, institutional controls, and hydraulic capture and containment of fluoride in groundwater. This report documents the installation of the FE/PWO system, which provides hydraulic capture and containment of fluoride in groundwater. The FE/PWO system is described more fully in *Specifications for Focused Extraction / Production Well Optimization for the RMC-Troutdale Facility* (CH2M HILL, April 2005). Source control removal actions are summarized in *Post-Demolition Remedial Investigation Report* (CH2M HILL, June 2006). Institutional controls restricting the use of shallow groundwater are a requirement of the Interim ROD and will be addressed in future documents.

Construction of the FE/PWO system began in July 2005 and was completed in October 2005. CH2M HILL was responsible for project design, bid document preparation, and submittal review. Tetra Tech ECI was the general contractor onsite, responsible for site safety; civil, mechanical, and electrical installation; system testing; and site cleanup. Construction activities were accomplished in accordance with *Specifications for Focused Extraction / Production Well Optimization for the RMC-Troutdale Facility* (CH2M HILL, April 2005).

System startup performance monitoring of the FE/PWO system began on November 4, 2005, and was completed in mid-November 2005. Monthly operational monitoring of the FE/PWO system was initiated on November 21, 2005, and was completed in May 2006 in accordance with the following plans:

- *Memorandum WP No. 68: Sitewide Groundwater Monitoring Plan (2006 Through 2010) at RMC-Troutdale* (CH2M HILL, October 2005)
- *Memorandum WP No. 69: Focused Extraction and Production Well Optimization System Startup Performance Monitoring Plan* (CH2M HILL, November 2005)

Monitoring of system performance is currently being performed quarterly according to the requirements in *Memorandum WP No. 68: Sitewide Groundwater Monitoring Plan (2006 Through 2010) at RMC-Troutdale* (CH2M HILL, October 2005). This sitewide groundwater monitoring plan provides the procedures and requirements necessary to monitor groundwater for the next 5 years.

## 2.1 Focused Extraction/Production Well Optimization System

The FE/PWO system provides for the interception of high-fluoride-containing groundwater migrating from the silt unit to the UGS zone (scrap yard and east potliner areas). It also provides for the capture and removal of fluoride-containing groundwater that exceeds drinking water MCLs in the Intermediate Sand and Deep Sand/Gravel zones (south plant area). On the basis of numerical groundwater flow modeling, two focused extraction wells

pumping at a total rate of approximately 40 gallons per minute (gpm) and two production wells pumping at a total flow rate of approximately 1,200 gpm are required to achieve final selected remedy objectives. On the basis of initial modeling results, two focused extraction wells (FE-02 and FE-03) were installed in the south plant in 2004 using cable tool drilling techniques (*Memorandum WP No. 65: Work Plan for Focused Extraction System Design and Installation* [CH2M HILL, December 2004]). The focused extraction wells are located along the north side of the scrap yard and west of the east potliner area. Production well water from production wells PW07 and PW08 (with backup capacity from PW03 and PW05) is blended with the focused extraction well water prior to discharge to the Columbia River in compliance with the plant's existing NPDES permit (Oregon Permit No. 100757).

Major construction elements for the FE/PWO system included the following:

- Modification of aboveground wellheads at production wells PW03, 05, 07, and 08 to include new ductile iron pipe, check and gate valves, pressure indicators, and heat tracing
- Installation of pumps and controls at focused extraction wells FE02 and FE03, including isolation and check valves, flow meters, pressure indicators, and heat tracing
- Removal of the pump and motor from PW18 and reinstallation at PW05
- Installation of conveyance piping from the focused extraction and production wells to Building 70 for blending and discharge into the existing NPDES discharge line.
- Upgrades to Building 70 to support installation of the motor control center, electrical panels, NPDES sampling point/sink, focused extraction and production well line plumbing, and a programmable logic computer for system operation.

A general layout of the FE/PWO system is shown on Figure 2-1. Detailed system as-built drawings of the FE/PWO system are included as Appendix A.

## 2.2 Performance Monitoring

Long-term groundwater monitoring will be conducted to evaluate the effectiveness of the completed and ongoing cleanup actions. Monitoring and reporting for the first 5 years will be accomplished in accordance with *Memorandum WP No. 68: Sitewide Groundwater Monitoring Plan (2006 Through 2010) at RMC-Troutdale* (CH2M HILL, October 2005).

**LEGEND**

- ▲ PRODUCTION WELL LOCATION
- ● FOCUSED EXTRACTION WELL LOCATION
- ■ MONITORING WELL LOCATION
- ——— PIPING ALIGNMENT

COLUMBIA RIVER

SANDY RIVER

12" PVC

8" PVC

8" PVC

8" PVC

4" PVC

4" PVC

4" PVC

PW03

PW05

PW08

PW07

MW33

MW34

MW49

MW55

FE02

MW35

MW56

FE03

FE01

MW02

N

0 500 1000

FIGURE 2-1
FE/PWO SYSTEM LAYOUT

CH2MHILL

PLOT DATE: 23-Oct-2006 FILENAME: \\Rosa\proj\ALCOA\166034\CAD\JAN05NEW\166034_Figure 1 v2.dwg

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**SECTION 3**

# FE/PWO System Modifications

The FE/PWO system was constructed and installed in accordance with *Specifications for Focused Extraction/Production Well Optimization System for the RMC-Troutdale Facility* (CH2M HILL, April 2005). No major modifications to the original design concept/basis or specifications package were allowed. The following is a listing of minor changes approved in the field:

- Relocation of 12-inch discharge line north to align with existing roadway
- Substitution of thrust block for restrained pipe connections at 12-inch discharge pipe to 16-inch NPDES pipe connection
- Substitution of direct burial electrical wire for conduit
- Minor plumbing realignments in Building 70 to improve trip hazards and access issues
- Addition of NPDES automatic ISCO sampling port, equipment, and piping within Building 70
- Relocation of 12-inch discharge line exit from Building 70
- Flow meter substitution for FE02 and FE03

SECTION 4

# Performance Monitoring

Startup performance monitoring of the system began on November 4, 2005, and was completed in mid-November 2005, as detailed in *Focused Extraction and Production Well Optimization System Startup Performance Monitoring Plan* (CH2M HILL, November 2005). Startup monitoring included implementation of the following:

- Step tests at FE02 and FE03
- One week of baseline monitoring
- Constant-rate pump tests at FE02 and FE03

Continuous operation and performance monitoring of the FE/PWO system began on November 21, 2005, and was completed in May 2006 in accordance with the following work plans:

- *Memorandum WP No. 68: Sitewide Groundwater Monitoring Plan (2006 Through 2010) at RMC-Troutdale* (CH2M HILL, October 2005)
- *Memorandum WP No. 69: Focused Extraction and Production Well Optimization System Startup Performance Monitoring Plan* (CH2M HILL, November 2005)

Monitoring of system performance is currently being performed quarterly according to the requirements in *Memorandum WP No. 68: Sitewide Groundwater Monitoring Plan (2006 Through 2010) at RMC-Troutdale* (CH2M HILL, October 2005). This sitewide groundwater monitoring plan provides the procedures and requirements necessary to monitor groundwater for the next 5 years.

Detailed results from the system startup and 5-month performance monitoring of the FE/PWO system are presented in Appendix B. This presentation was provided to representatives of EPA and the Oregon Department of Environmental Quality (DEQ) on May 25, 2006, and finalized and documented in *Technical Memorandum GW No. 35, Focused Extraction/Production Well Optimization System Startup Performance Monitoring Results and Conclusions* (CH2M HILL, June 27, 2006). Data collected during system startup and performance monitoring activities and performance implications are summarized below:

- Pumping rates for FE02 and FE03 achieved 27 and 25 gpm, respectively. These pumping rates exceed the Interim ROD requirement.
- Contour maps and drawdown plots demonstrate that the FE wells' pumping influence extends to the edge of existing fluoride plumes. Observed performance validates previous model results. System performance is consistent with the model and the Interim ROD.
- Fluoride and cyanide concentrations initially decreased in FE02 after startup. By the end of the performance monitoring period, fluoride and cyanide concentrations equilibrated at 40 milligrams per liter (mg/L) and 4 mg/L, respectively.

- Fluoride and cyanide concentrations initially increased in FE03 after startup. By the end of the performance monitoring period, fluoride and cyanide concentrations equilibrated at 20 mg/L and 0.1 mg/L, respectively.
- Drawdown and data evaluation validate conclusions that no additional focused extraction wells are required to establish hydraulic control in areas where fluoride concentrations exceed the limits established in the Interim ROD.
- One additional monitoring well in the east potliner area was recommended to improve system performance assessment. This well, MW58, was installed in September 2006.
- The FE/PWO system is meeting Interim ROD remedial action objectives.

On the basis of FE/PWO system startup and performance monitoring data collected in 2005 and 2006, the startup and operation requirements identified in the Groundwater UAO (EPA, August 5, 2005) have been satisfied and the FE/PWO system is capable of meeting established performance criteria.

SECTION 5

# Operations and Maintenance

The FE/PWO system is designed to provide hydraulic containment of fluoride plumes in the south plant area and to capture and remove high-fluoride-concentration groundwater in the vicinity of the scrap yard and east potliner areas. During system operation, groundwater is removed through a combination of shallow focused extraction wells (FE02 and FE03) and a minimum of two of four deep production wells (PW3, PW5, PW7, and PW8). Groundwater from the focused extraction wells flows through a 4-inch-diameter underground pipe to Building 70, where it is mixed with water from PW07 and PW08 (or PW03 and PW05 during backup conditions). Groundwater from the production wells is transported to Building 70 via 8- and 10-inch-diameter underground pipe. After mixing, the combined flow from the FE/PWO system is discharged to a 12-inch-diameter underground pipe that connects to an existing 16-inch-diameter underground pipe located adjacent to Sundial Road. The 16-inch-diameter pipe discharges to the Columbia River under an existing NPDES permit (Oregon Permit No. 100757). Figure 5-1 schematically illustrates the general flow, mixing, and discharge of the extracted groundwater by the FE/PWO system.

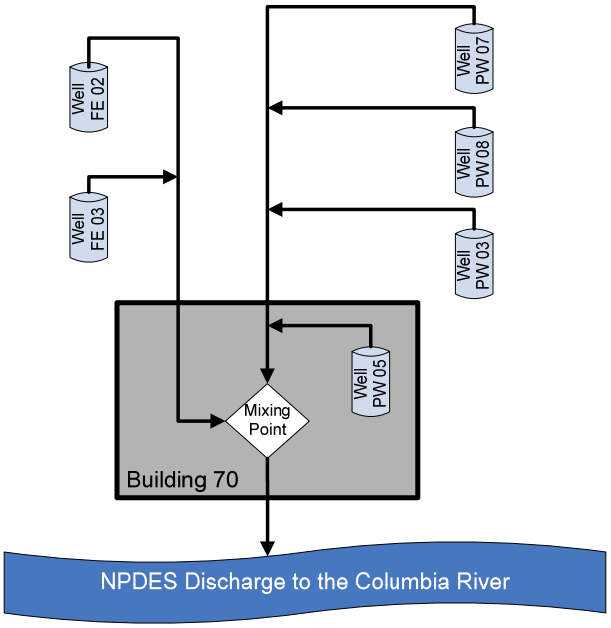



Figure 5-1 Generalized FE/PWO System Configuration and Operation Diagram

Operations and maintenance (O&M) of the FE/PWO system are expected to continue for a minimum of 5 years. Regular inspection, maintenance, and troubleshooting of the FE/PWO system are required throughout this period. Required O&M activities are attached as Appendix C (*Operation, Inspection, and Maintenance Manual – Focused Extraction/Production Well Optimization System, RMC-Troutdale Facility* [CH2M HILL, October 2006]).

SECTION 6

# Costs

Costs for the FE/PWO system installation are summarized in Table 6-1. Included in the table are costs for CH2M HILL, Tetratech ECI, and other subcontractors. Costs incurred by EPA and RMC/Alcoa are not included.

TABLE 6-1
Summary of Costs for Focused Extraction/Production Well Optimization System Installation

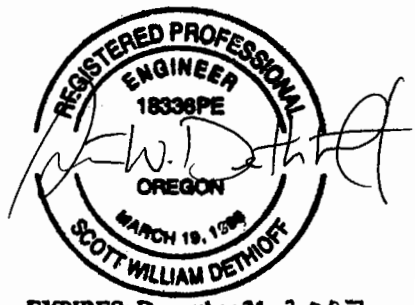
| Contractor | Description of Work | Cost* |
|---|---|---|
| CH2M HILL | Preliminary FE Well Design<br>• *Work planning*<br>• *Design basis development*<br>• *Reporting* | $109,132 |
| CH2M HILL,<br>Geotech Exploration/<br>Boart Longyear | FE Well Design and Installation<br>• *Detailed design*<br>• *Well Drilling and Installation Services*<br>• *Reporting* | $70,683 |
| CH2M HILL | FE/PWO System Design<br>• *Engineering Support*<br>• *Work planning*<br>• *Design and specification preparation*<br>• *Owner construction oversight*<br>• *Agency submittals*<br>• *Reporting* | $ 206,085 |
| Tetratech ECI,<br>Turnkey Construction Services,<br>Tice Electric | System Installation<br>• *Mechanical /Electrical Services*<br>• *Pumps, Motor Control Center, Piping*<br>• *As-built drawings* | $671,082 |
| | **Total** | **$1,056,982** |

*EPA oversight and RMC/Alcoa costs not included.

SECTION 7

# Certification

Under penalty of law, I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of the report, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.




EXPIRES: December 31, 2007

Scott W. Dethloff, P.E.
Oregon Professional Engineer 18336 PE
CH2M HILL, Inc.

October 24, 2006
Date

Steven M. Shaw
Troutdale Superfund Project Coordinator
Reynolds Metals Company/Alcoa

October 23, 2006
Date

APPENDIX A

# FE/PWO System As-Built Drawings

| Rev | Date | By | Rem |
|---|---|---|---|
| A | 08/08/05 | KRW | SHOP RELEASE |
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| **PLC** | 15 | MCC CONTROL PANEL | 07/07/05 |
| **PLC** | 16 | MCC CONTROL PANEL | 07/08/05 |
| **PLC** | 17 | MCC LAYOUT | 07/08/05 |


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**FOCUSED EXTRACTION / PRODUCTION WELL OPTIMIZATION SYSTEM**
**TROUTDALE, OREGON**

PROJECT: 05-3853_ALCOA FE/PWO SYSTEM

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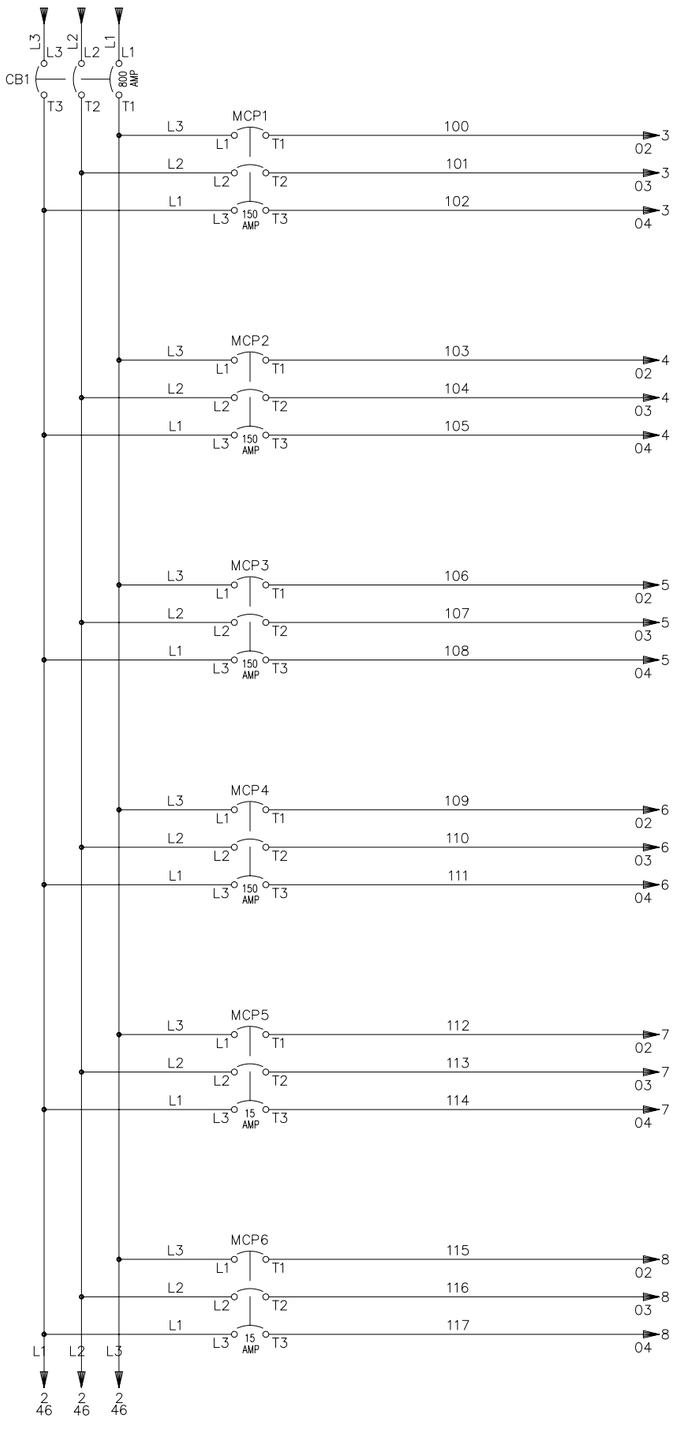


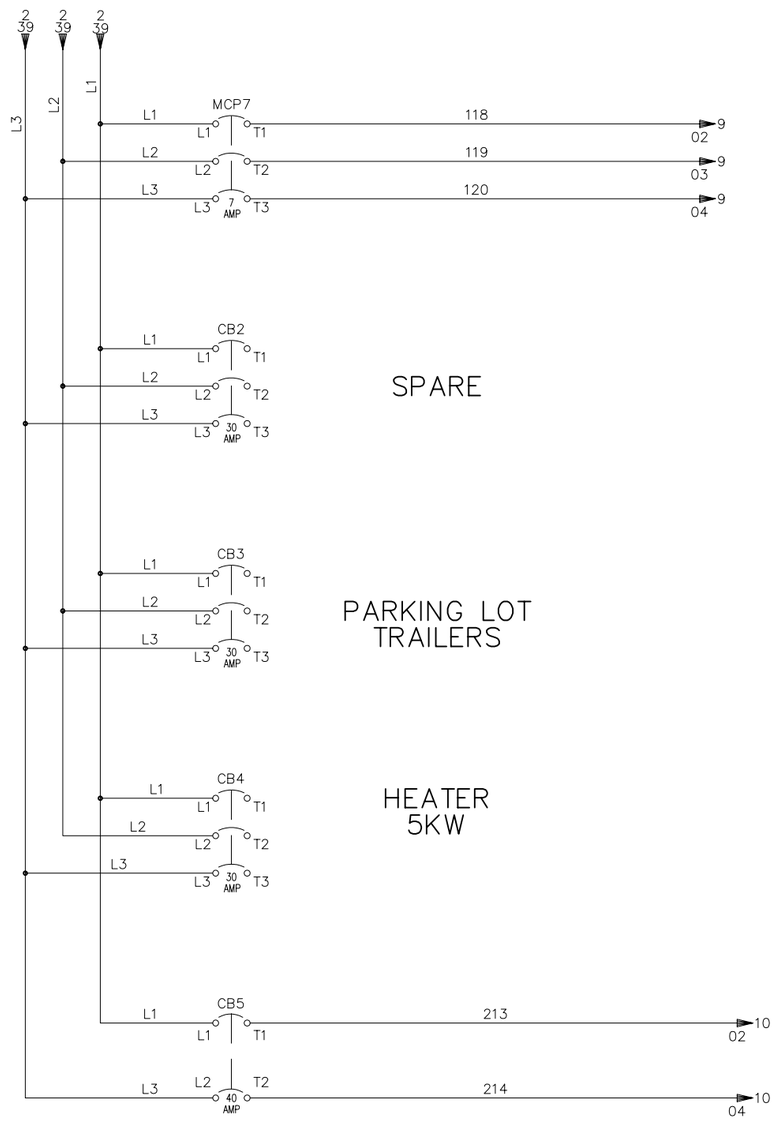



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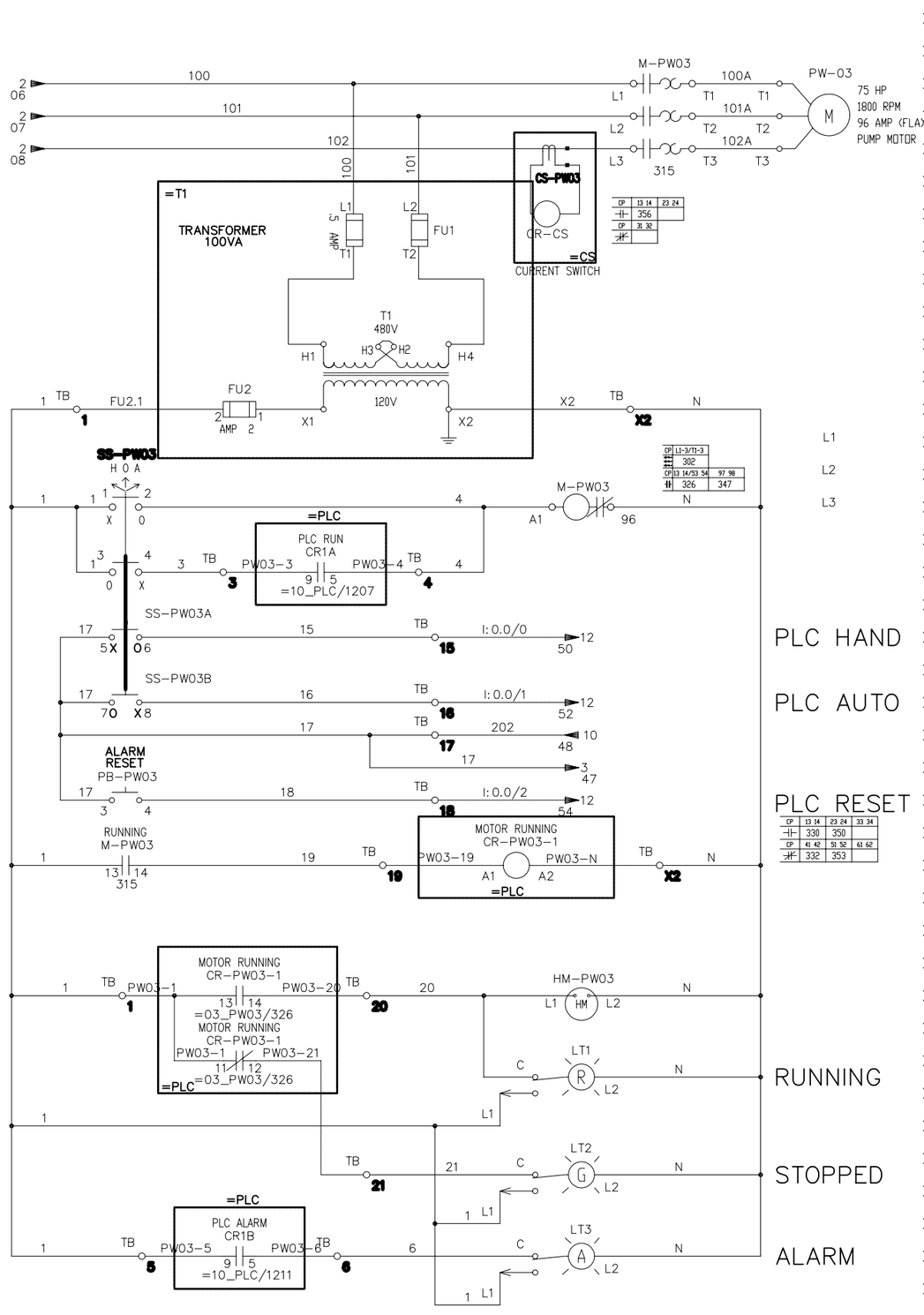


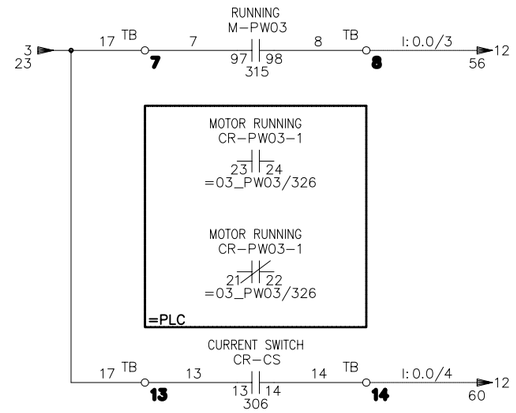



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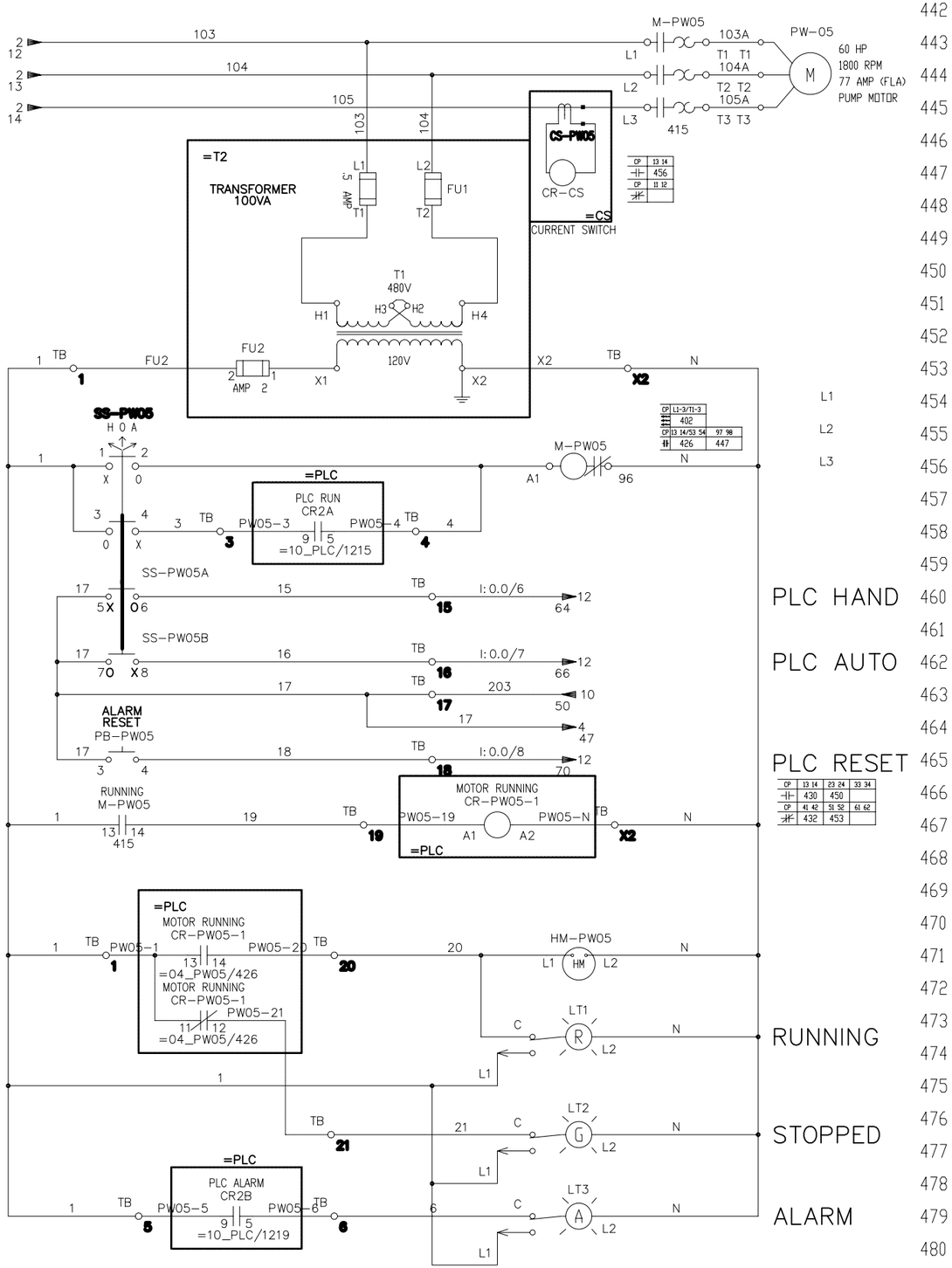


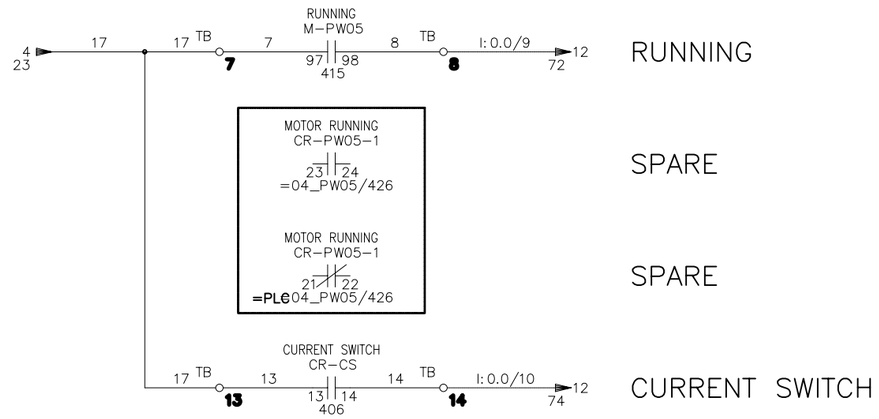



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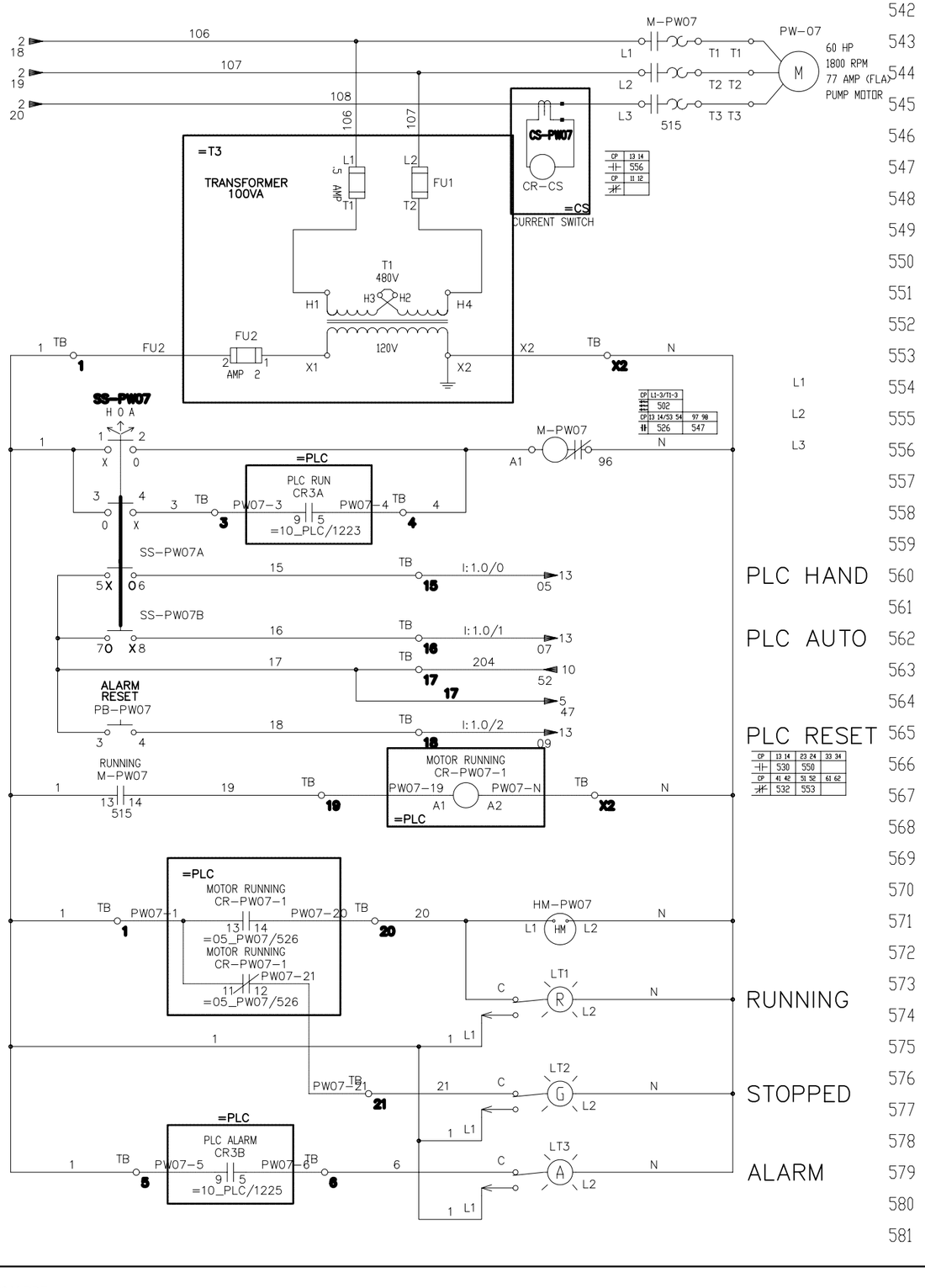


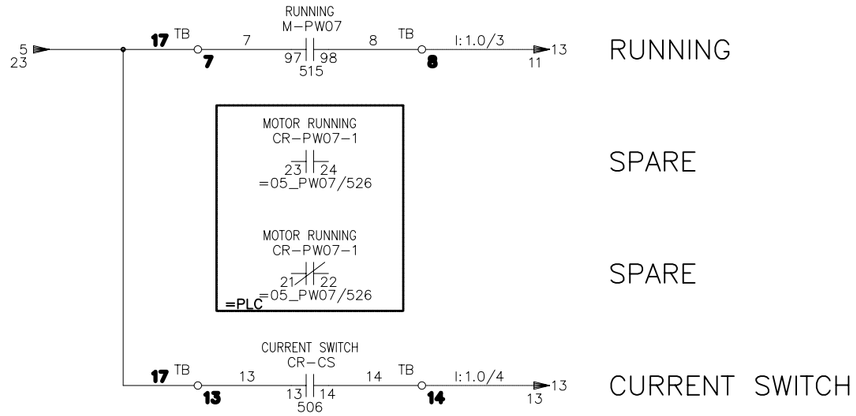



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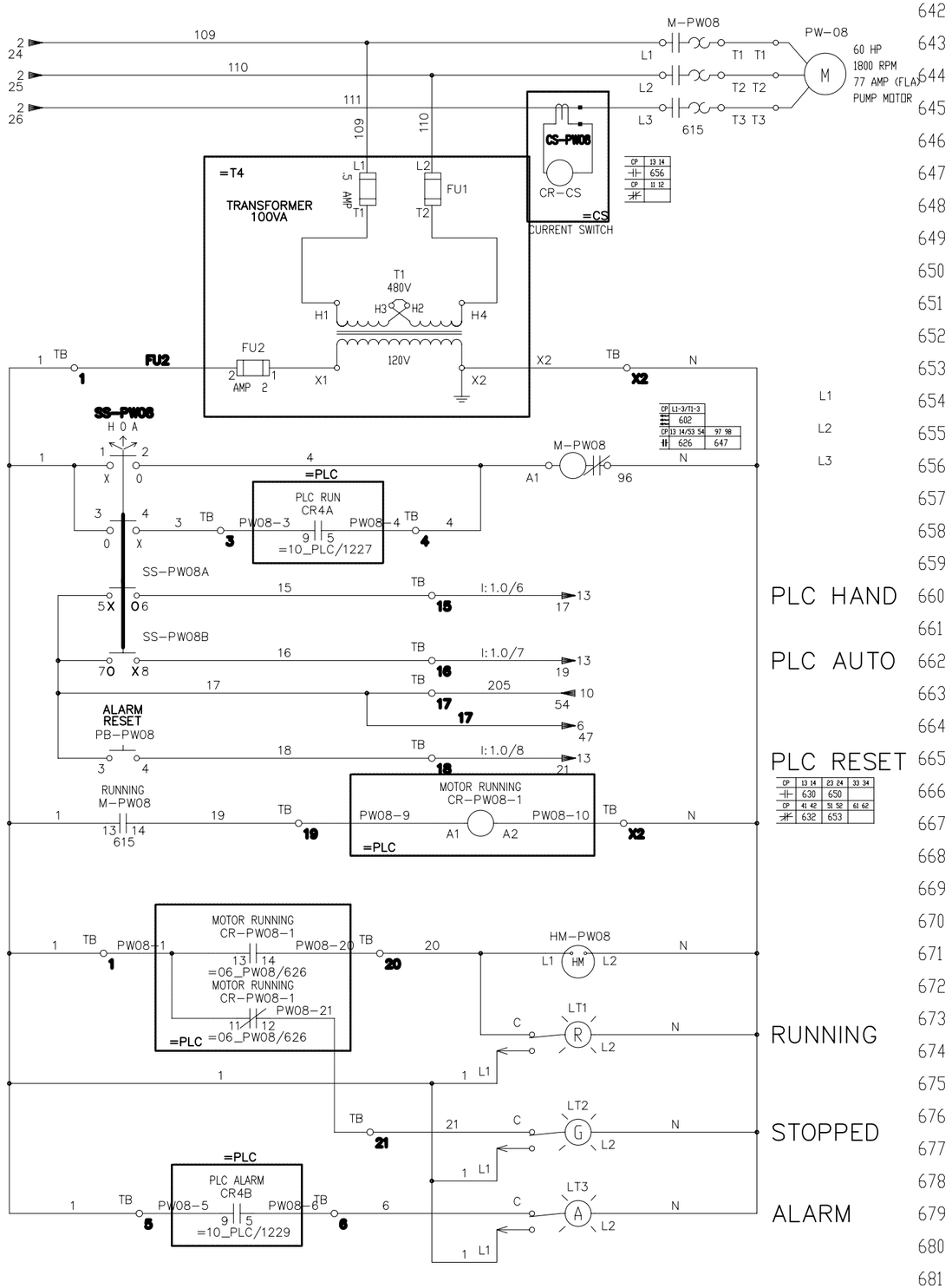


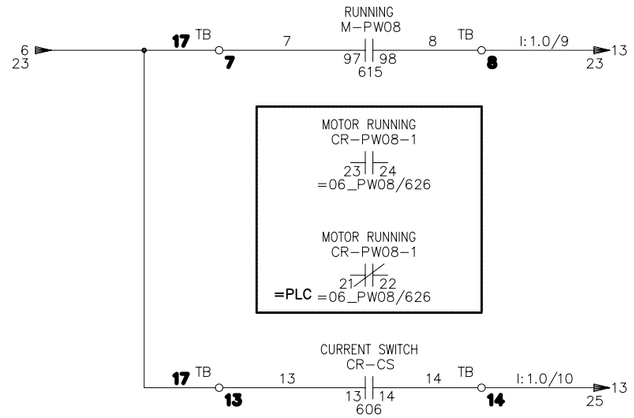



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| CKD | CDR | 08/08/05 |
| APPR | | |

REYNOLDS / ALCOA INC.
FOCUSED EXTRACTION / PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

PROJECT: 05-3853_ALCOA FE/PWO SYSTEM

DRAWING-NO: 05-3853-E Rev Level: C

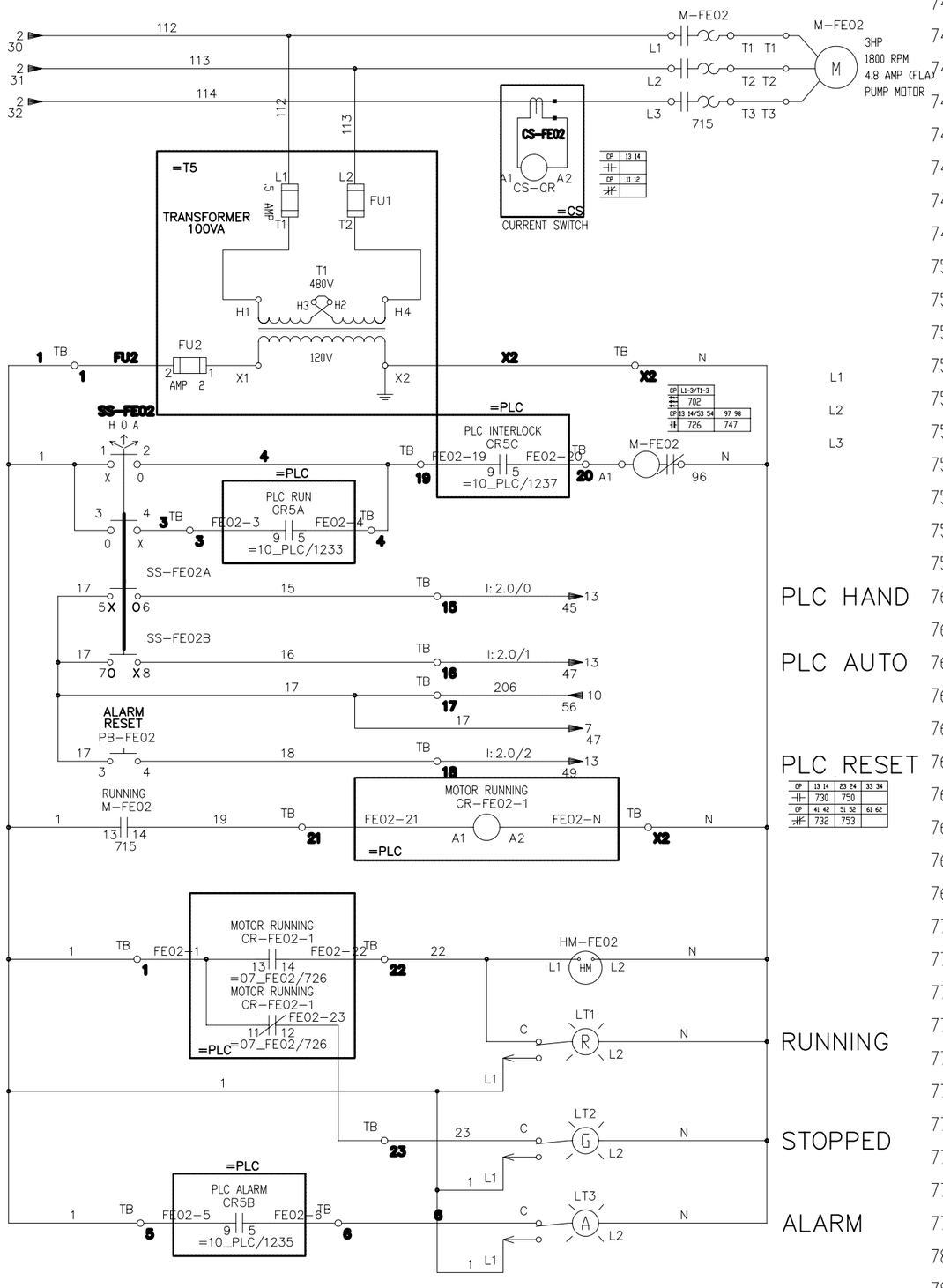
JOB-NO: 05-3853

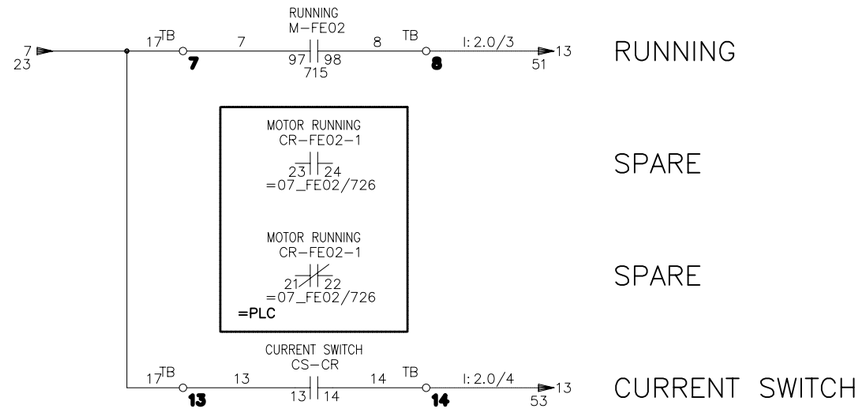
PAGE DESCRIPTION: MCC POWER DIST PRODUCTION WELL PW-08

INSTALLATION: 06_PW08

PAGE: 6 OF 17

| Rev: | Date: | By: | Rem: |
|---|---|---|---|
| A | 08/08/05 | KRW | SHOP RELEASE |
| B | 11/29/05 | KRW | FINAL AS BUILT |
| C | 03/28/06 | KRW | FINAL AS INSTALLED |





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REYNOLDS / ALCOA INC.
FOCUSED EXTRACTION / PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

PROJECT: 05-3853_ALCOA FE/PWO SYSTEM

DRAWING-NO: 05-3853-E Rev Level: C

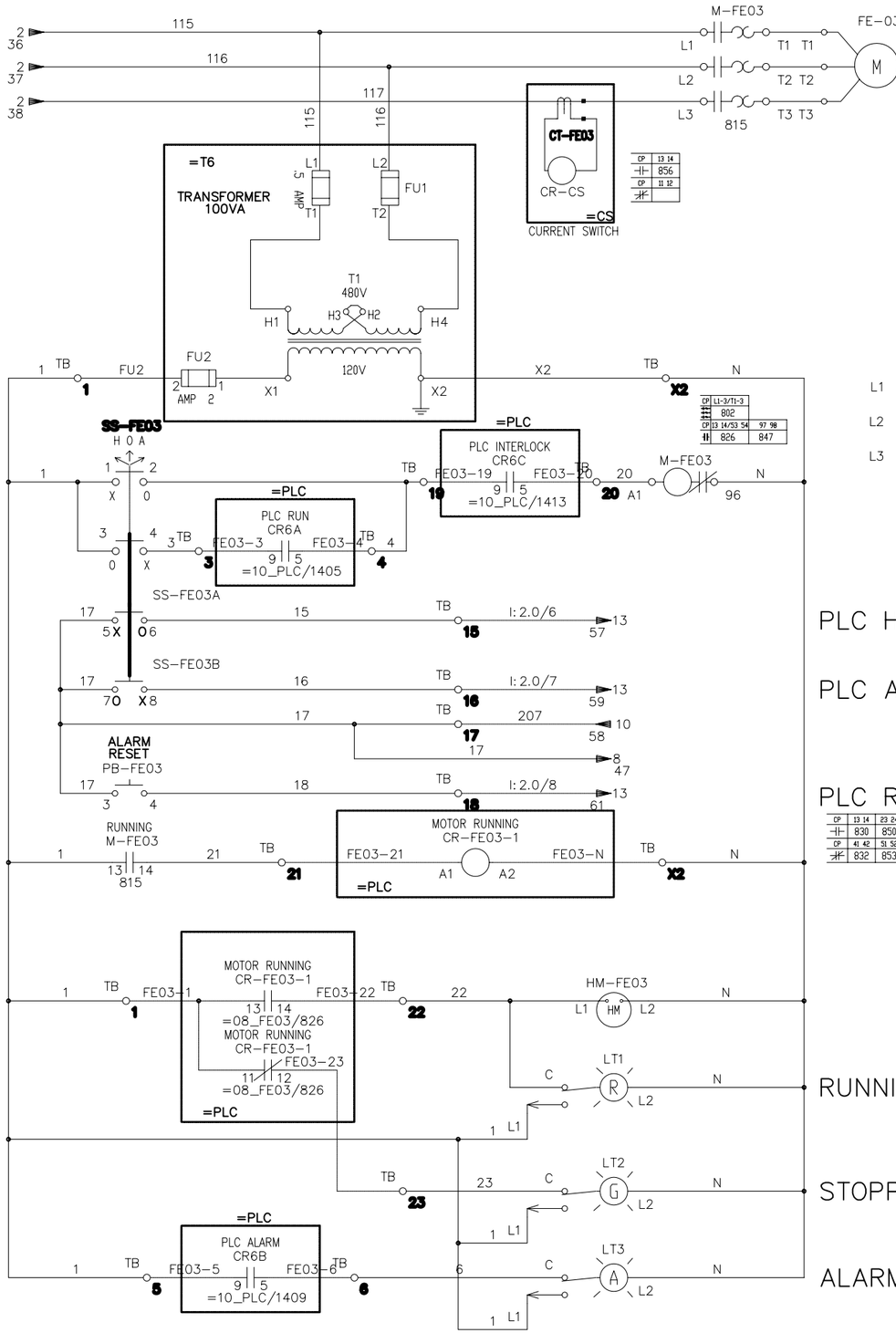
JOB-NO: 05-3853

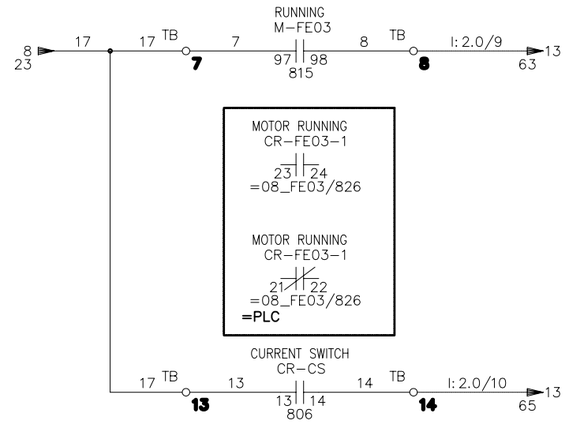
PAGE DESCRIPTION: MCC POWER DIST FOCUSED EXTRACTION WELL FE-02

INSTALLATION: 07_FE02

PAGE: 7 OF 17

| Rev | Date | By | Rem |
|---|---|---|---|
| A | 08/08/05 | KRW | SHOP RELEASE |
| B | 11/29/05 | KRW | FINAL AS BUILT |
| C | 03/28/06 | KRW | FINAL AS INSTALLED |





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| CKD | CDR | 08/08/05 |
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REYNOLDS / ALCOA INC.
**FOCUSED EXTRACTION / PRODUCTION WELL OPTIMIZATION SYSTEM**
**TROUTDALE, OREGON**

PROJECT: 05-3853_ALCOA FE/PWO SYSTEM

DRAWING-NO: 05-3853-E Rev Level: C

JOB-NO: 05-3853

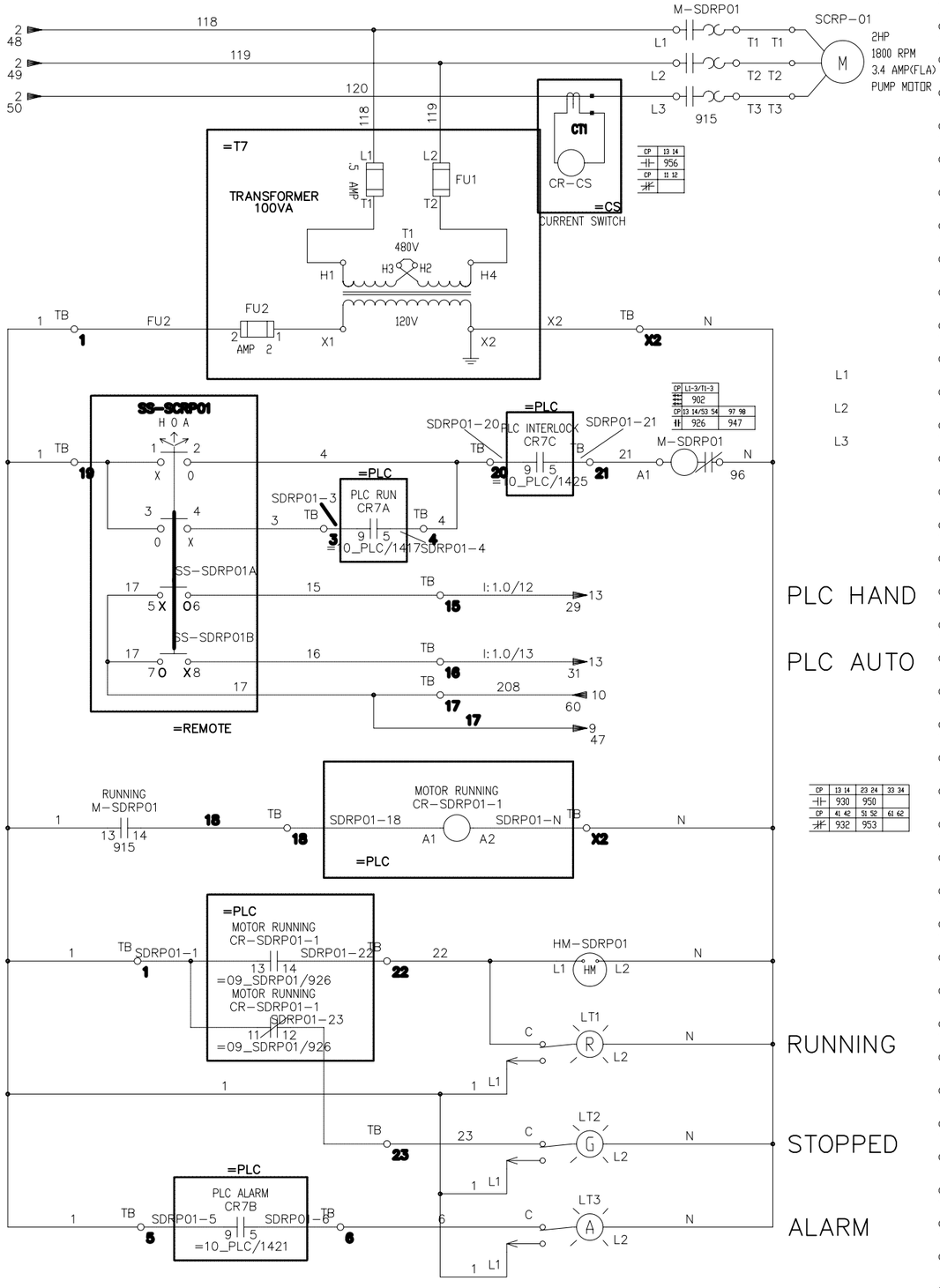
PAGE DESCRIPTION: MCC POWER DIST FOCUSED EXTRACTION WELL FE-03

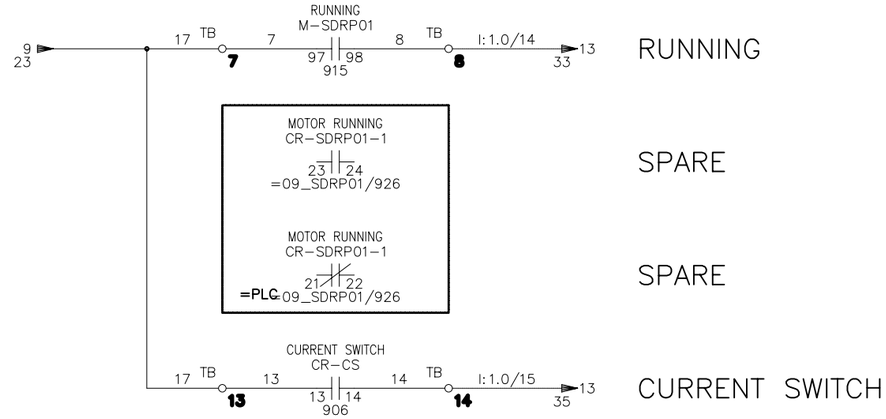
INSTALLATION: 08_FE03

PAGE: 8 OF 17

PDX/062960011.PDF

| Rev | Date | By | Remarks |
|---|---|---|---|
| A | 08/08/05 | KRW | SHOP RELEASE |
| B | 11/29/05 | KRW | FINAL AS BUILT |
| C | 03/28/06 | KRW | FINAL AS INSTALLED |





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| CKD | CDR | 08/08/05 |
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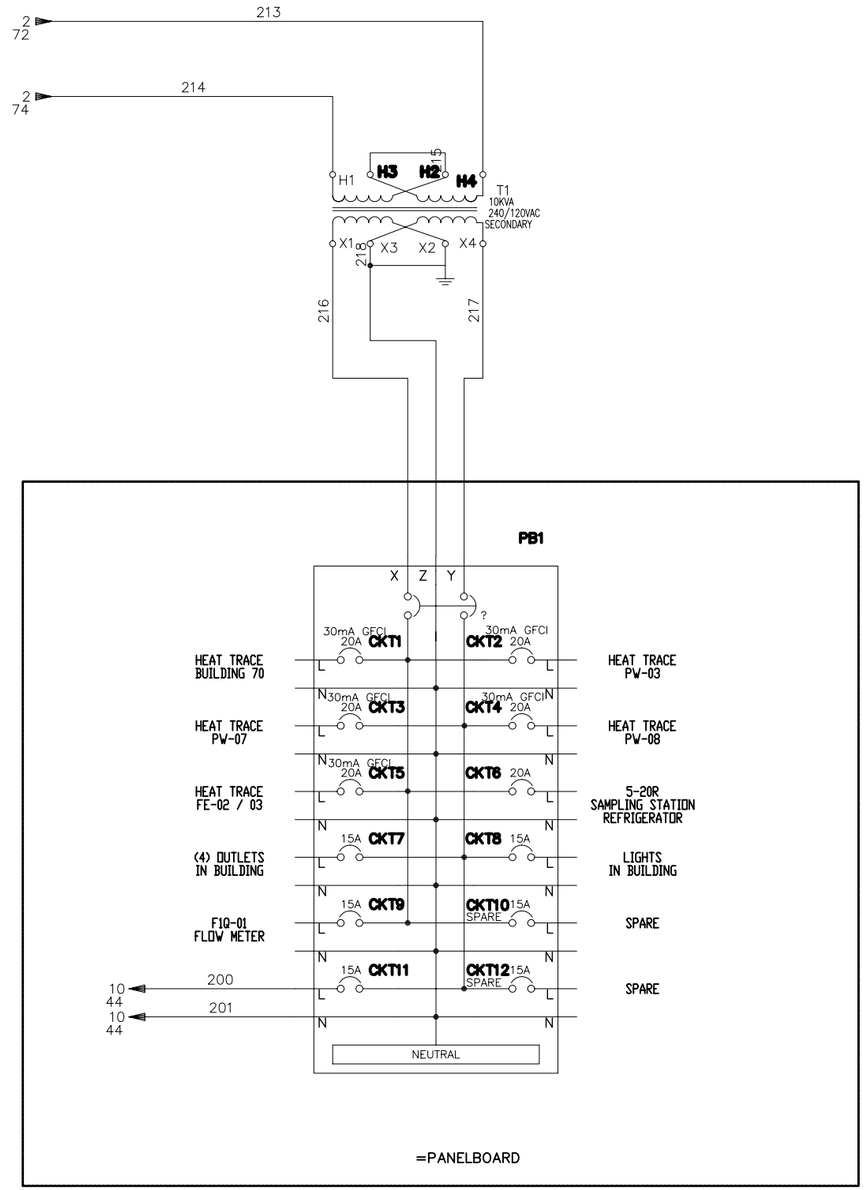
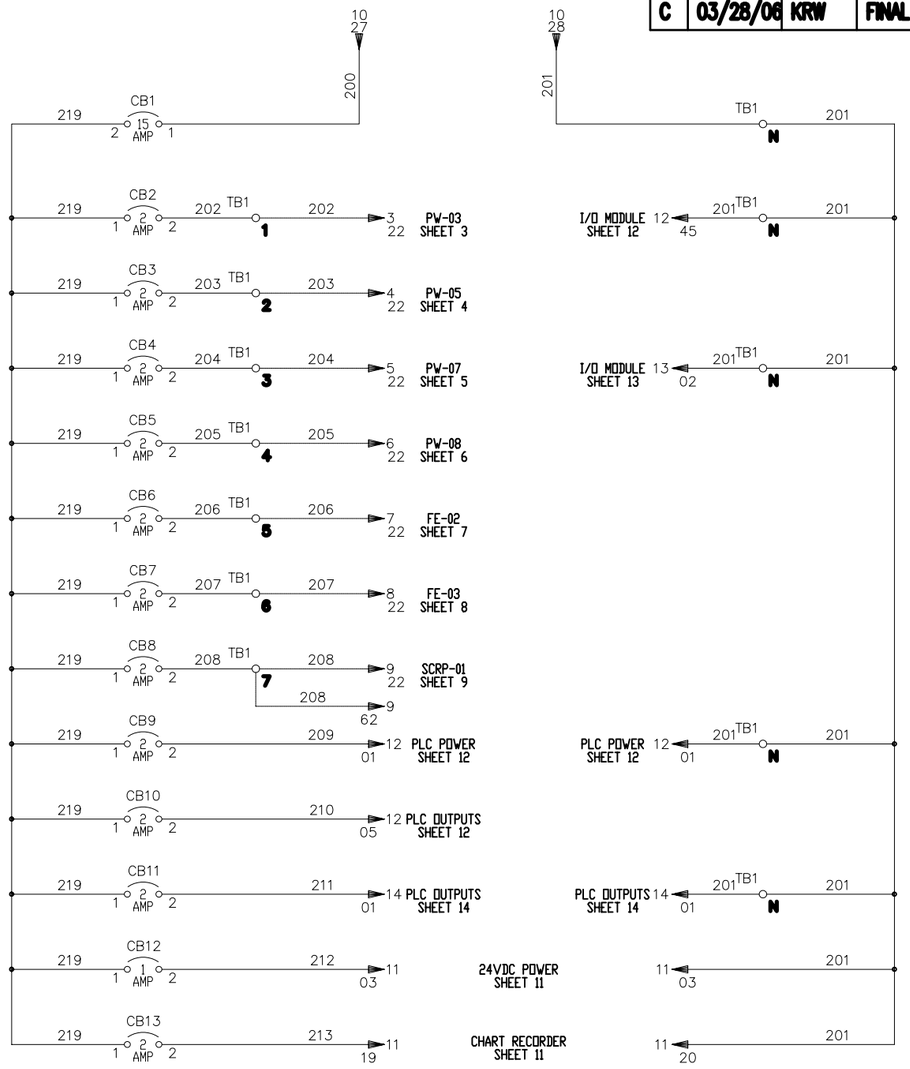
FOCUSED EXTRACTION / PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

PROJECT: 05-3853_ALCOA FE/PWO SYSTEM
DRAWING-NO: 05-3853-E Rev Level: C
JOB-NO: 05-3853
PAGE DESCRIPTION: MCC POWER DIST SAMPLE DISCHARGE RETURN PUMP SCRP-01
INSTALLATION: 09_SDRP01
PAGE: 9 OF 17

| Rev | Date | By | Rev |
|---|---|---|---|
| A | 08/08/05 | KRW | SHOP RELEASE |
| B | 11/29/05 | KRW | FINAL AS BUILT |
| C | 03/28/06 | KRW | FINAL AS INSTALLED |





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**FOCUSED EXTRACTION / PRODUCTION WELL OPTIMIZATION SYSTEM**
**TROUTDALE, OREGON**

PROJECT: 05-3853_ALCOA FE/PWO SYSTEM

DRAWING-NO: 05-3853-E Rev Level: C

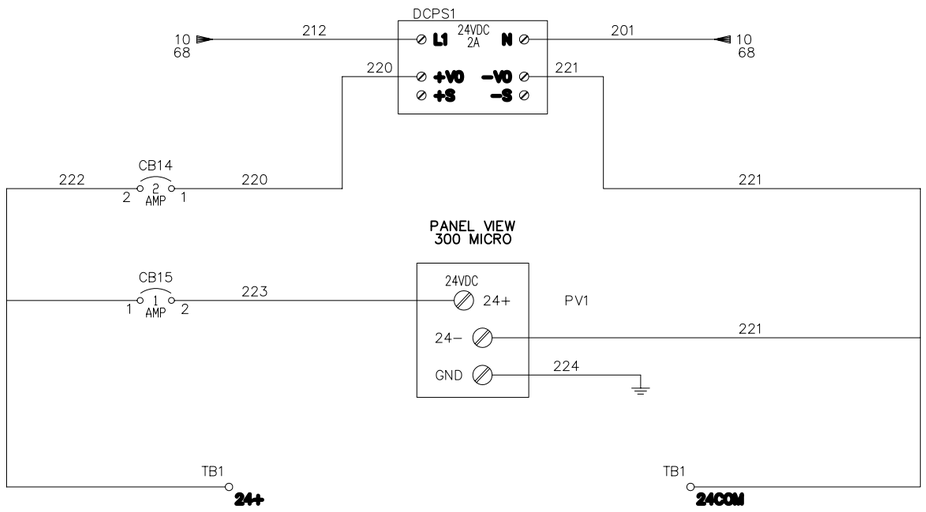
JOB-NO: 05-3853

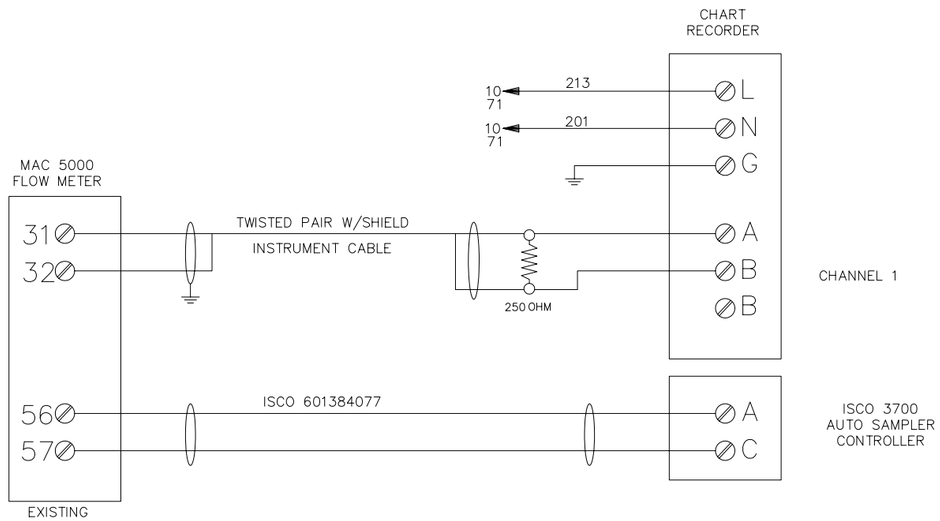
PAGE DESCRIPTION: MCC POWER DISTRIBUTION PLC POWER DIST SCHEMATIC

INSTALLATION: 10_PLC

PAGE: 10 OF 17

| Rev | Date | By | Rev |
|---|---|---|---|
| A | 08/08/05 | KRW | SHOP RELEASE |
| B | 11/29/05 | KRW | FINAL AS BUILT |
| C | 03/28/06 | KRW | FINAL AS INSTALLED |





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REYNOLDS / ALCOA INC.
FOCUSED EXTRACTION / PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

PROJECT: 05-3853_ALCOA FE/PWO SYSTEM

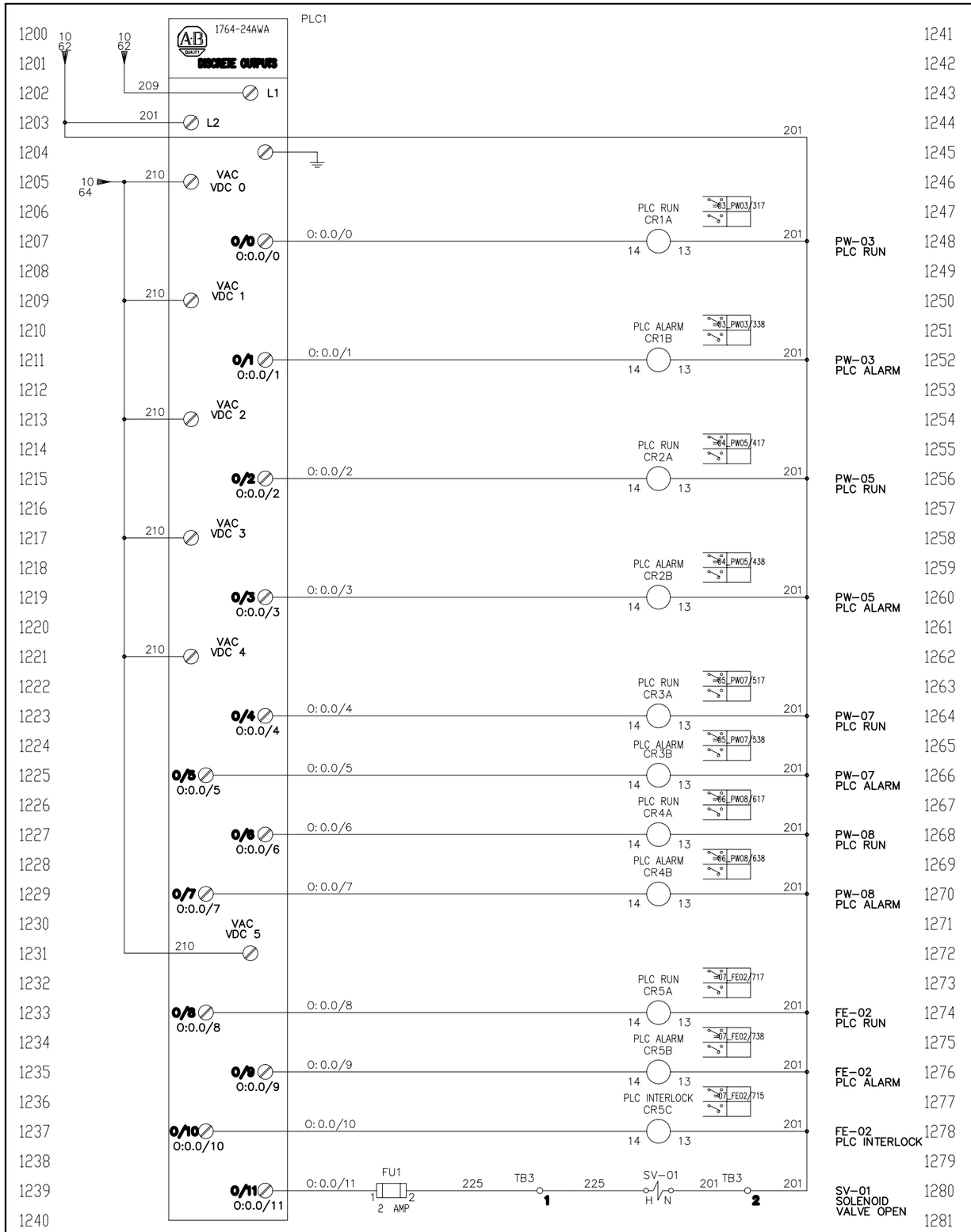
DRAWING-NO: 05-3853-E Rev Level: C

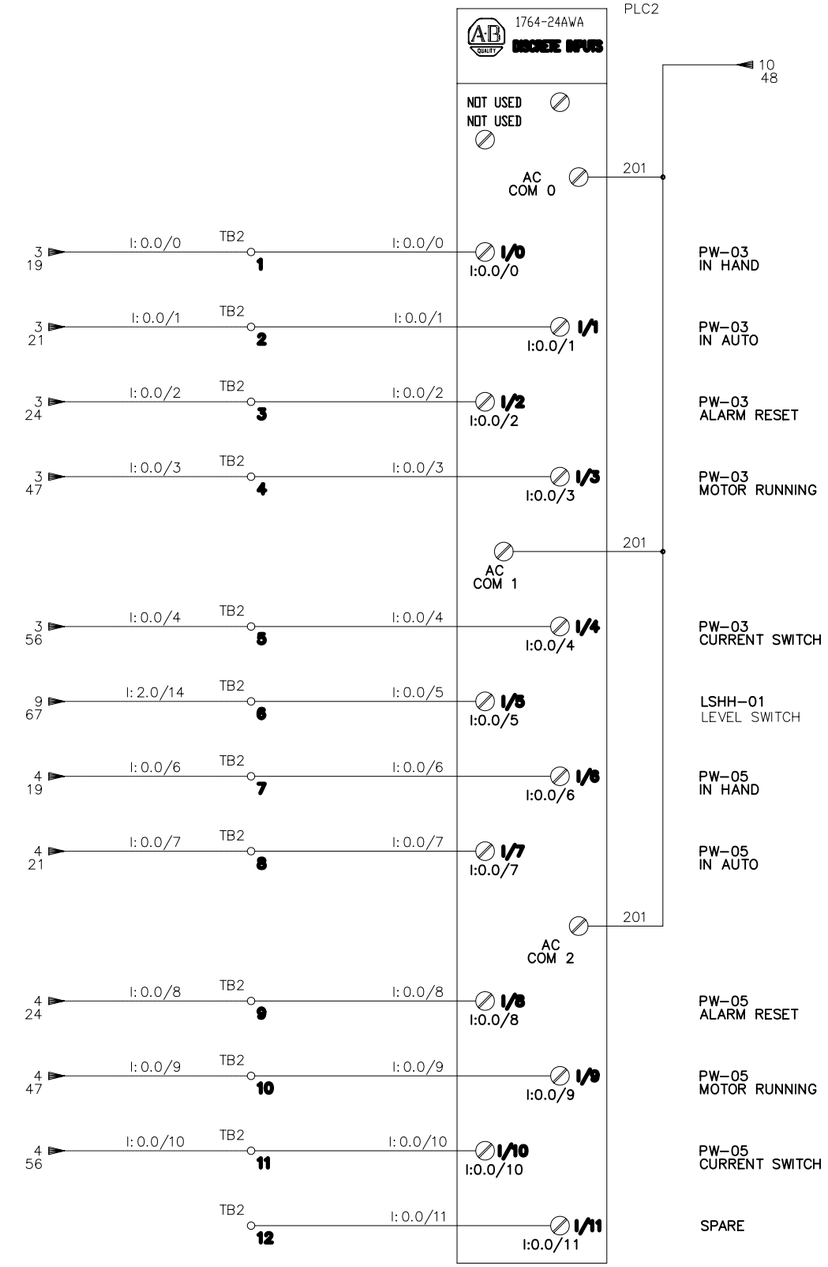
JOB-NO: 05-3853

PAGE DESCRIPTION: MCC POWER DISTRIBUTION 24VDC POWER DIST SCHEMATIC

INSTALLATION: 10_PLC

PAGE: 11 OF 17





PLC2
1764-24AWA
DISCRETE INPUTS
NOT USED
NOT USED
AC COM 0
AC COM 1
AC COM 2
10 48
201
I:0.0/0 I/0 PW-03 IN HAND
I:0.0/1 I/1 PW-03 IN AUTO
I:0.0/2 I/2 PW-03 ALARM RESET
I:0.0/3 I/3 PW-03 MOTOR RUNNING
I:0.0/4 I/4 PW-03 CURRENT SWITCH
I:2.0/14 I:0.0/5 I/5 LSHH-01 LEVEL SWITCH
I:0.0/6 I/6 PW-05 IN HAND
I:0.0/7 I/7 PW-05 IN AUTO
I:0.0/8 I/8 PW-05 ALARM RESET
I:0.0/9 I/9 PW-05 MOTOR RUNNING
I:0.0/10 I/10 PW-05 CURRENT SWITCH
I:0.0/11 I/11 SPARE
TB2 1 2 3 4 5 6 7 8 9 10 11 12

| Rev | Date | By | Description |
|---|---|---|---|
| A | 08/08/05 | KRW | SHOP RELEASE |
| B | 11/29/05 | KRW | FINAL AS BUILT |
| C | 03/28/06 | KRW | FINAL AS INSTALLED |

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REYNOLDS / ALCOA INC.
**FOCUSED EXTRACTION / PRODUCTION WELL OPTIMIZATION SYSTEM**
**TROUTDALE, OREGON**

PROJECT: 05-3853_ALCOA FE/PWO SYSTEM

DRAWING-NO: 05-3853-E Rev Level: C

JOB-NO: 05-3853

PAGE DESCRIPTION: MCC CONTROL SCHEMATIC; PLC I/O BASE WIRING SCHEMATIC

INSTALLATION: 10_PLC

PAGE: 12 OF 17

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|---|---|---|---|
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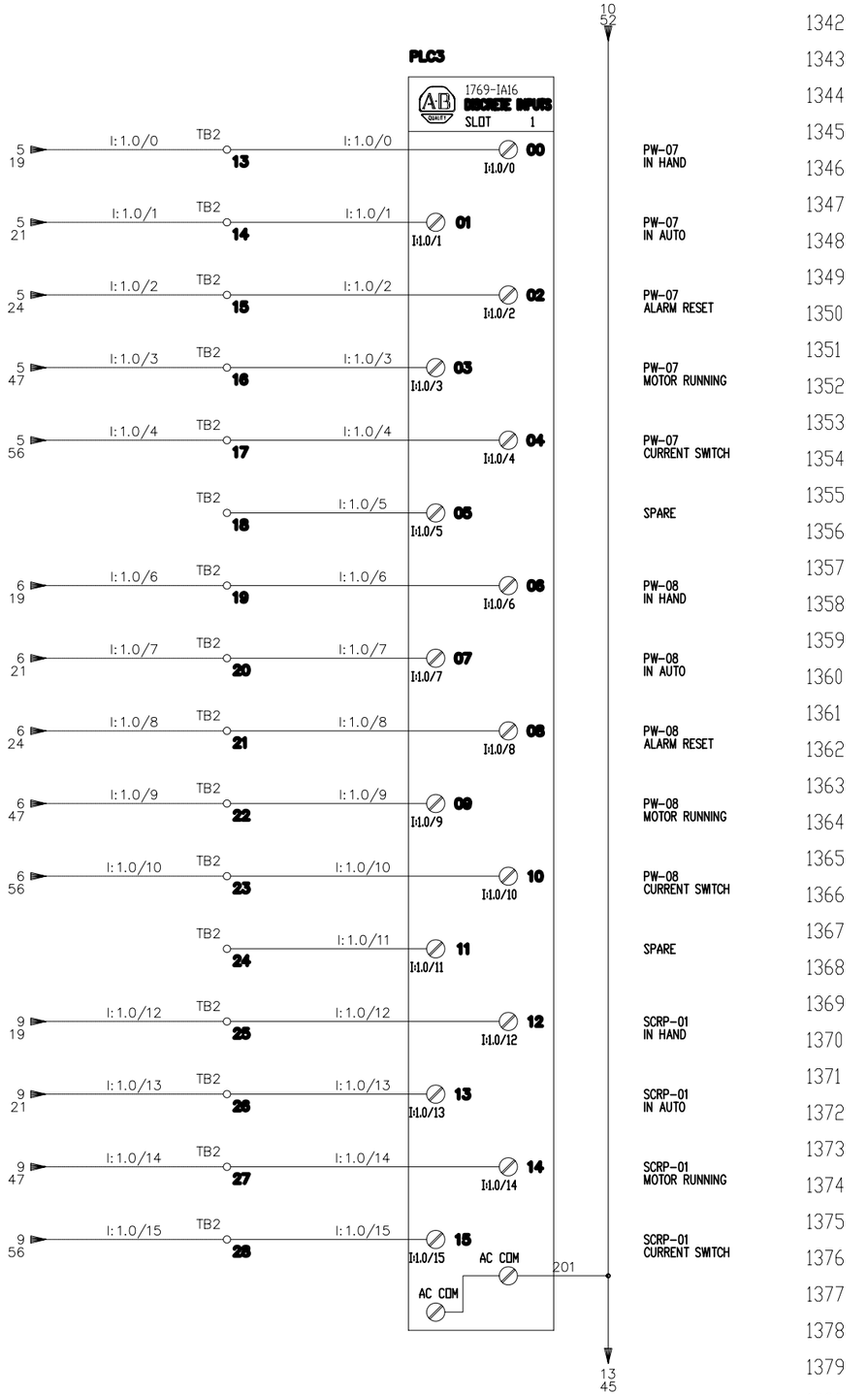
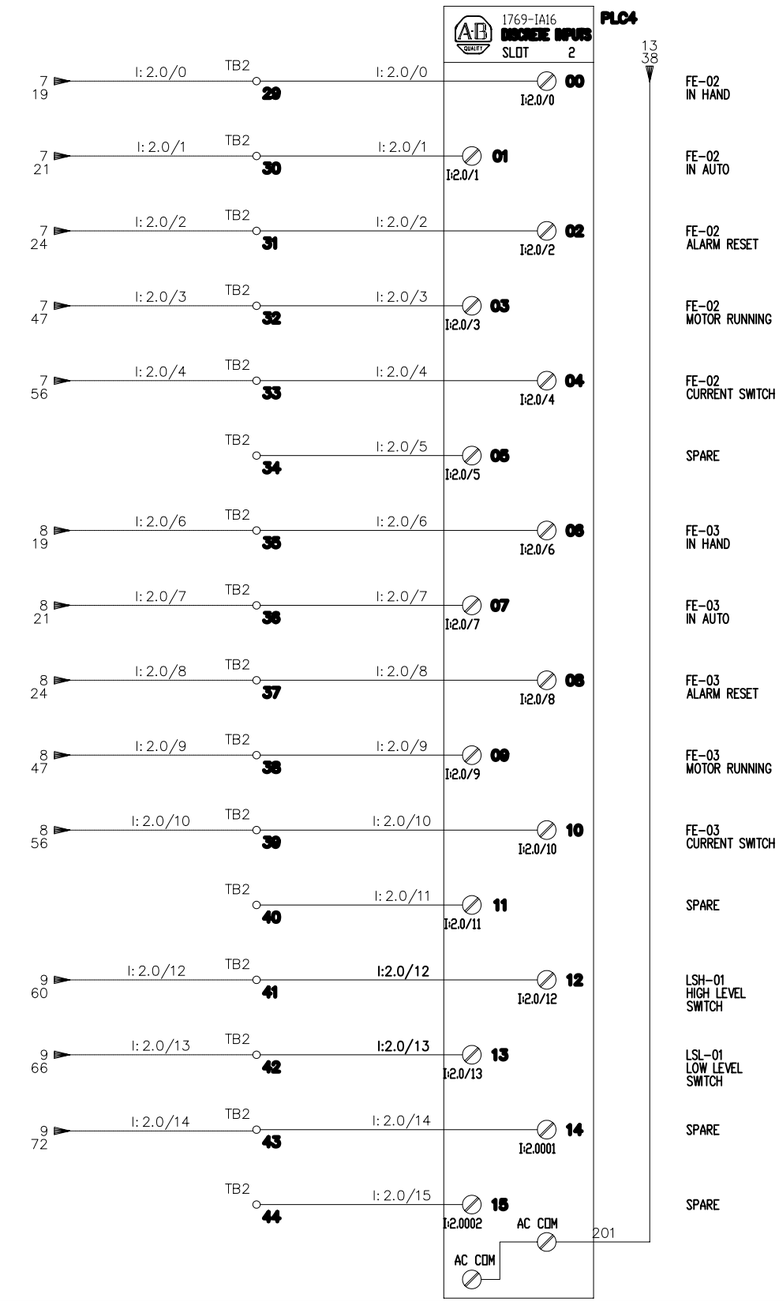
| B | 11/29/05 | KRW | FINAL AS BUILT |
| C | 03/28/06 | KRW | FINAL AS INSTALLED |




| | NAME | DATE |
|---|---|---|
| DRAWN | KRW | 07/07/05 |
| CKD | CDR | 08/08/05 |
| APPR | | |

REYNOLDS / ALCOA INC.
**FOCUSED EXTRACTION / PRODUCTION WELL OPTIMIZATION SYSTEM**
**TROUTDALE, OREGON**

PROJECT: 05-3853_ALCOA FE/PWO SYSTEM

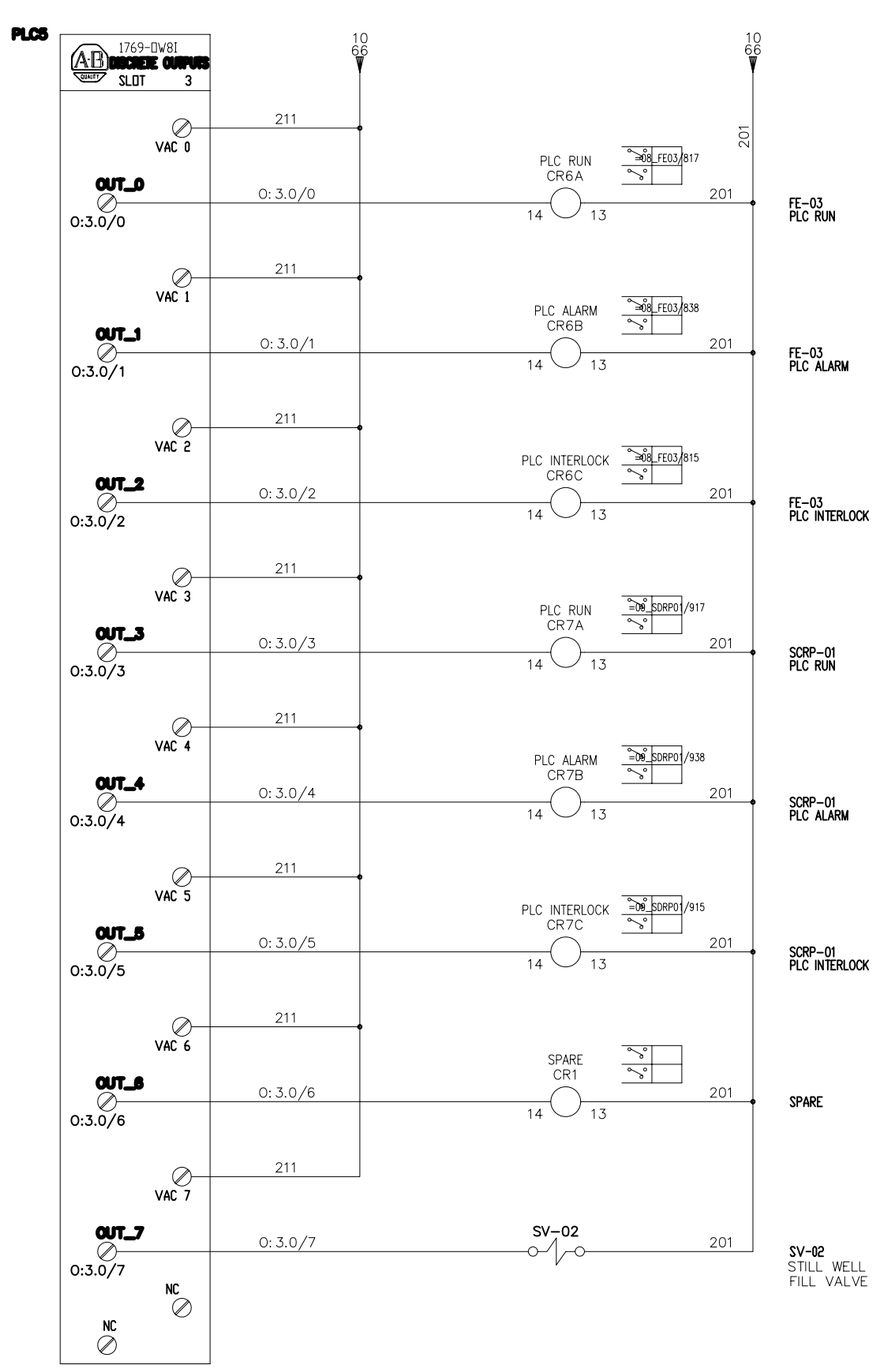
DRAWING-NO: 05-3853-E Rev Level: C

JOB-NO: 05-3853

PAGE DESCRIPTION: MCC CONTROL SCHEMATIC PLC I/O DISCRETE INPUTS

INSTALLATION: 10_PLC

PAGE: 13 OF 17

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| A | 08/08/05 | KRW | SHOP RELEASE |
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| C | 03/28/06 | KRW | FINAL AS INSTALLED |

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| | NAME | DATE |
|---|---|---|
| DRAWN | KRW | 07/07/05 |
| CKD | CDR | 08/08/05 |
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REYNOLDS / ALCOA INC.
**FOCUSED EXTRACTION / PRODUCTION WELL OPTIMIZATION SYSTEM**
**TROUTDALE, OREGON**

PROJECT: 05-3853_ALCOA FE/PWO SYSTEM

DRAWING-NO: 05-3853-E Rev Level: C

JOB-NO: 05-3853

PAGE DESCRIPTION: MCC CONTROL SCHEMATIC PLC I/O DISCRETE OUTPUTS

INSTALLATION: 10_PLC

PAGE: 14 OF 17

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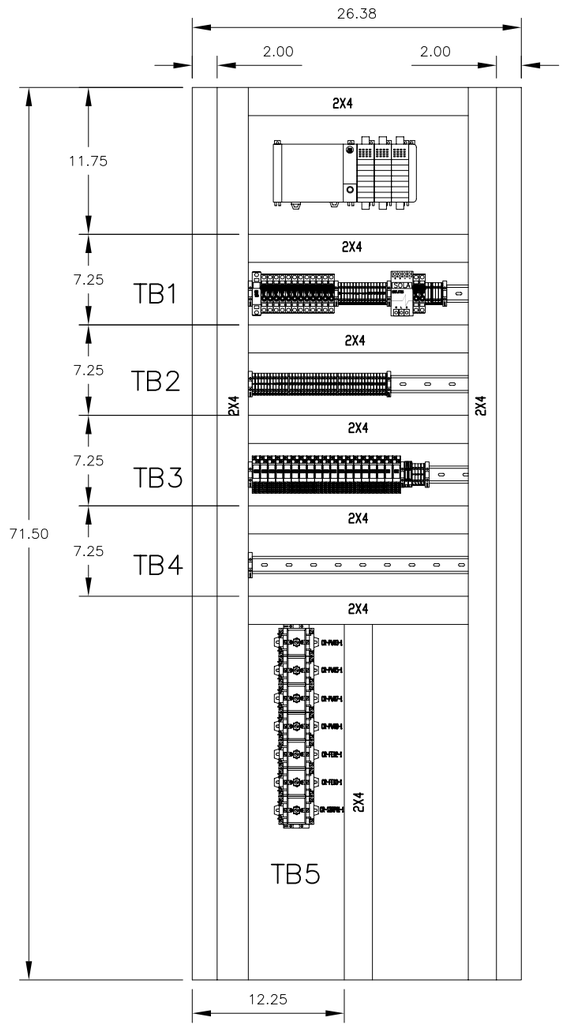
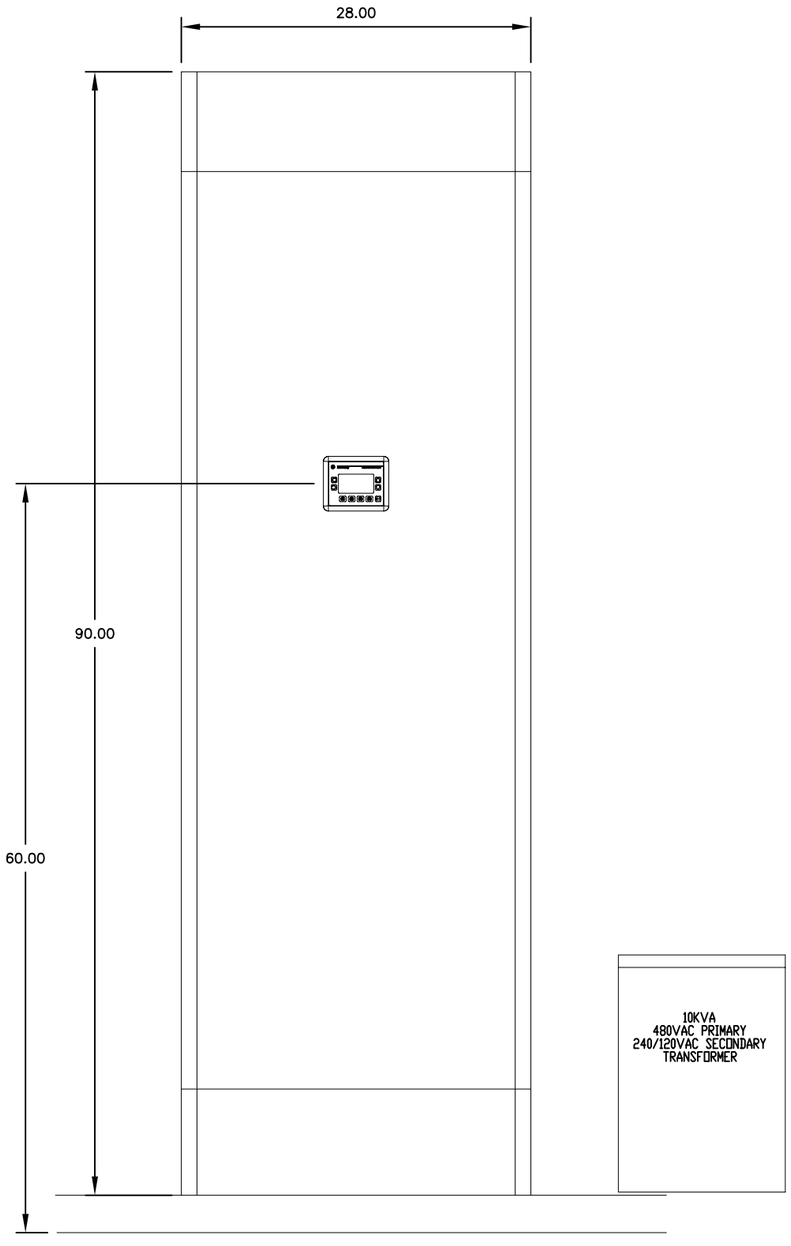
| C | 03/28/06 | KRW | FINAL AS INSTALLED |

ACTUAL LALYOUT MAY
CHANGE DURING CONSTRUCTION




| | NAME | DATE |
|---|---|---|
| DRAWN | KRW | 07/07/05 |
| CKD | CDR | 08/08/05 |
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REYNOLDS / ALCOA INC.
**FOCUSED EXTRACTION / PRODUCTION WELL OPTIMIZATION SYSTEM**
**TROUTDALE, OREGON**

PROJECT:
05-3853_ALCOA
FE/PWO SYSTEM

DRAWING-NO: 05-3853-E
Rev Level: C

JOB-NO: 05-3853

PAGE DESCRIPTION
MCC CONTROL PANEL
PANEL LAYOUT

INSTALLATION: 10_PLC

PAGE: 15 OF 17

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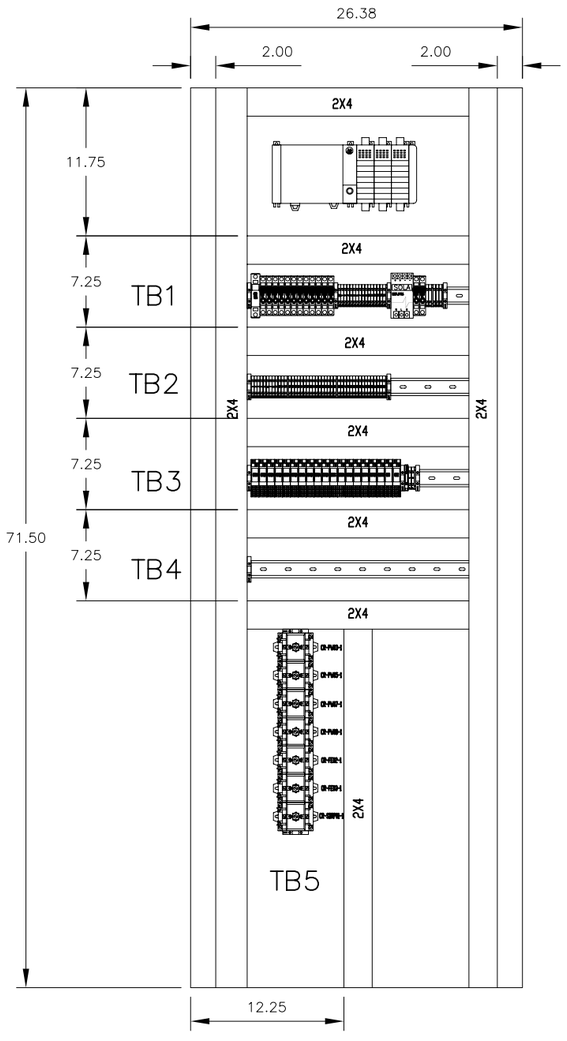
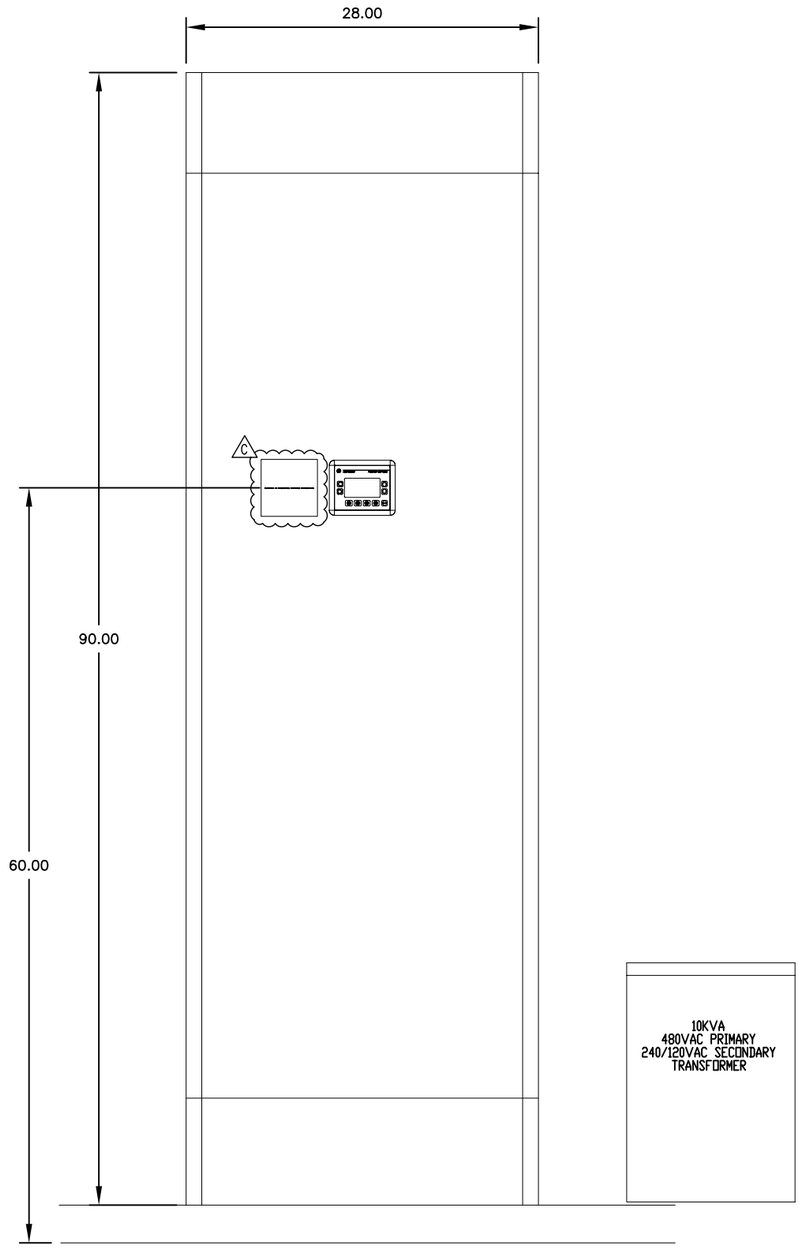
| A | 08/08/05 | KRW | SHOP RELEASE |
| B | 11/29/05 | KRW | FINAL AS BUILT |
| C | 01/07/06 | JRT | SYSTEM MODIFICATIONS BY CH2M HILL |

ACTUAL LALYOUT MAY
CHANGE DURING CONSTRUCTION

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| CKD | CDR | 08/08/05 |
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REYNOLDS / ALCOA INC.
**FOCUSED EXTRACTION / PRODUCTION WELL OPTIMIZATION SYSTEM**
**TROUTDALE, OREGON**

PROJECT: 05-3853_ALCOA FE/PWO SYSTEM

DRAWING-NO: 05-3853-E Rev Level: B

JOB-NO: 05-3853

PAGE DESCRIPTION: MCC CONTROL PANEL PANEL LAYOUT

INSTALLATION: 10_PLC

PAGE: 15 OF 17

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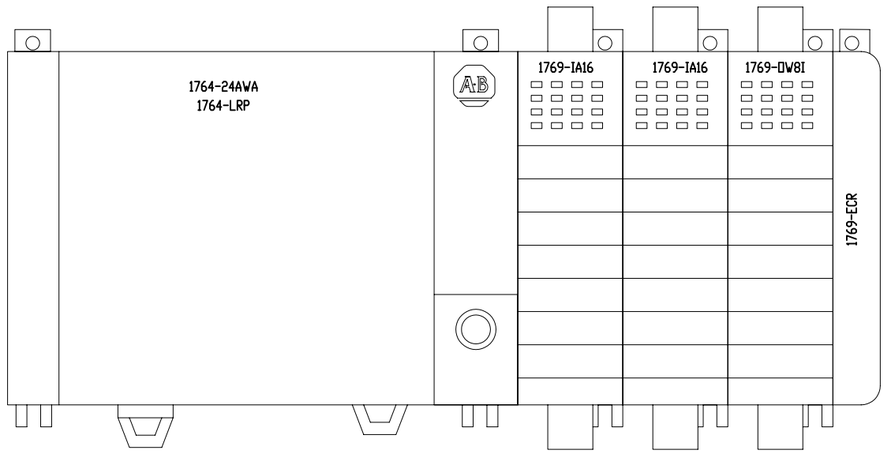


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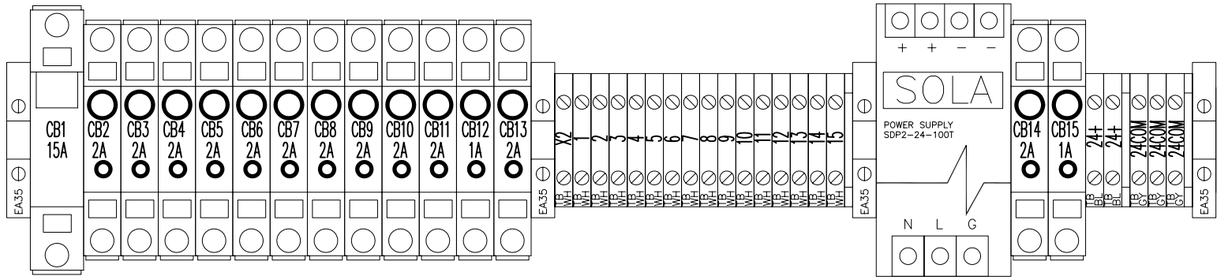
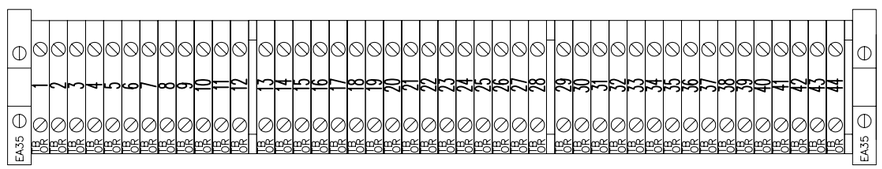
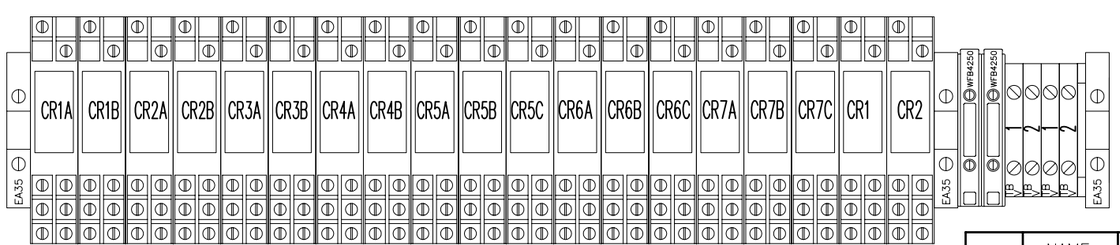



TB2




TB3

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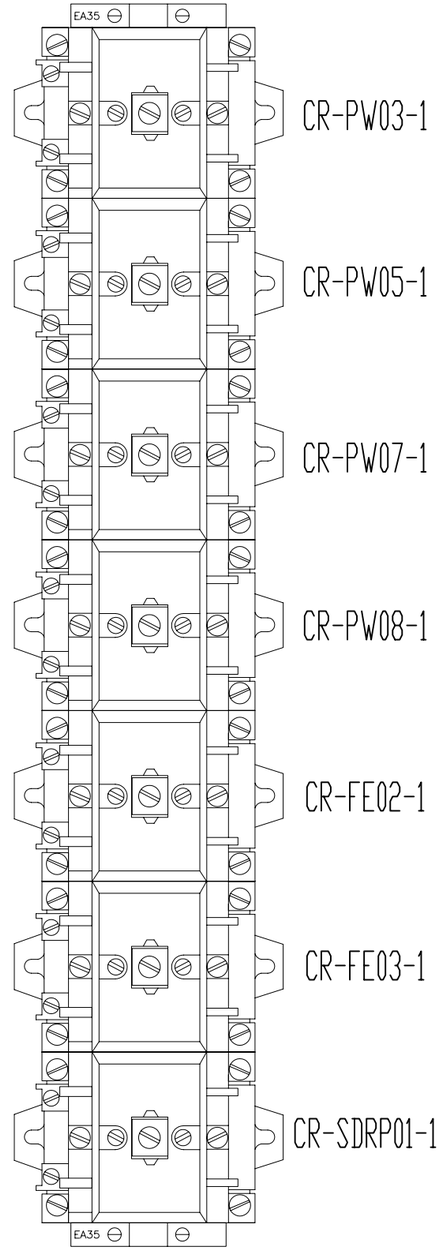


| | NAME | DATE |
|---|---|---|
| DRAWN | KRW | 07/08/05 |
| CKD | CDR | 08/08/05 |
| APPR | | |

REYNOLDS / ALCOA INC.
**FOCUSED EXTRACTION / PRODUCTION WELL OPTIMIZATION SYSTEM**
**TROUTDALE, OREGON**

PROJECT:
05-3853_ALCOA
FE/PWO SYSTEM

DRAWING-NO: 05-3853-E
Rev Level: C

JOB-NO: 05-3853

PAGE DESCRIPTION
MCC CONTROL PANEL
TERMINAL DETAILS

INSTALLATION: 10_PLC

PAGE: 16 OF 17

TAURUS POWER AND CONTROLS, INC.
9999 S.W. Avery St. · Tualatin, Oregon 97062
(503) 692-9004 FAX: (503) 692-9273

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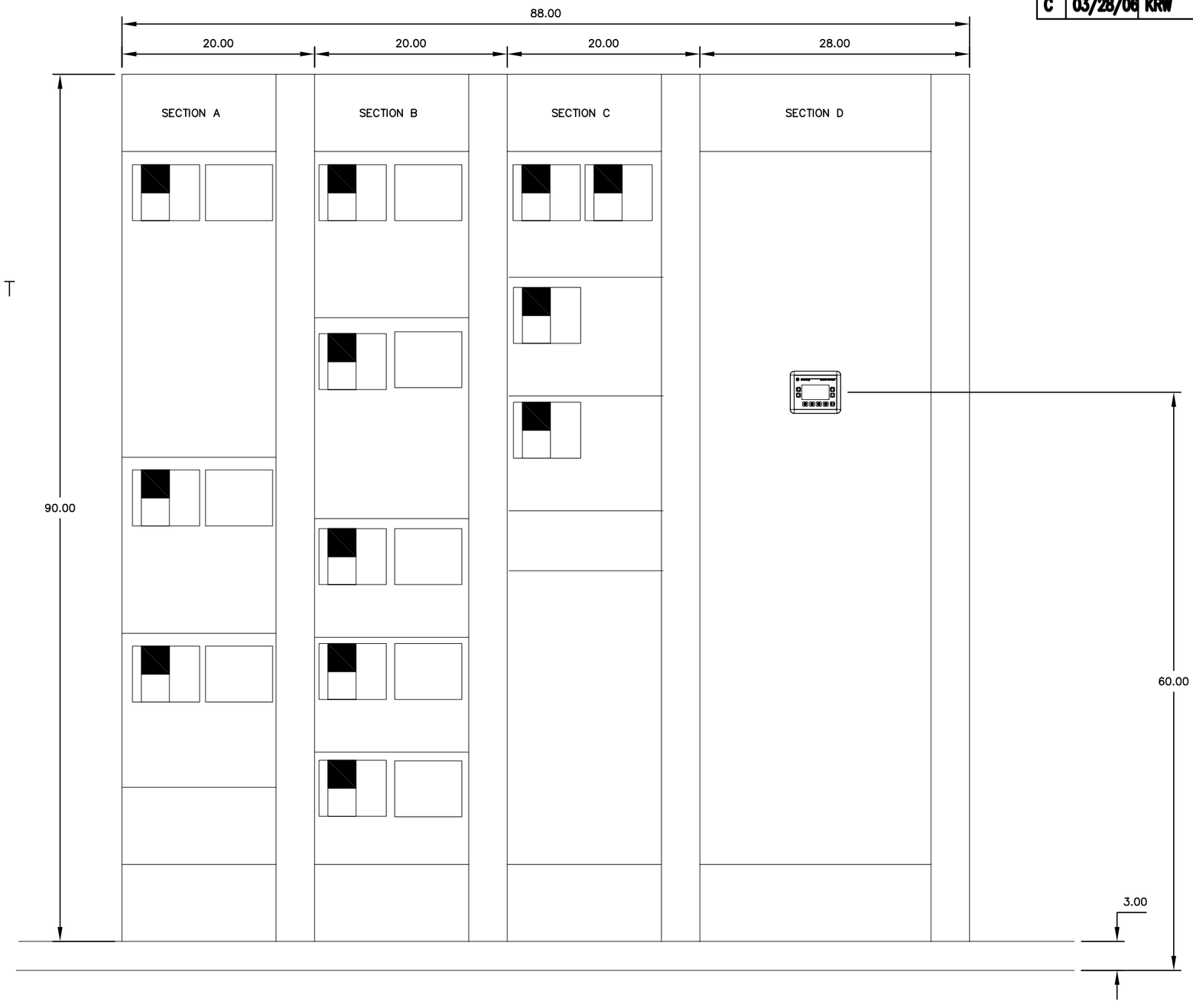
| Rev | Date | By | Remarks |
|---|---|---|---|
| A | 08/08/05 | KRW | SHOP RELEASE |
| B | 11/29/05 | KRW | FINAL AS BUILT |
| C | 03/28/06 | KRW | FINAL AS INSTALLED |

SEE MCC MANUFACTURER LAYOUT
FOR BUCKET DETAILS




| | NAME | DATE |
|---|---|---|
| DRAWN | KRW | 07/08/05 |
| CKD | CDR | 08/08/05 |
| APPR | | |

REYNOLDS / ALCOA INC.
**FOCUSED EXTRACTION / PRODUCTION WELL OPTIMIZATION SYSTEM**
**TROUTDALE, OREGON**

PROJECT: 05-3853_ALCOA FE/PWO SYSTEM

DRAWING-NO: 05-3853-E Rev Level: C

JOB-NO: 05-3853

PAGE DESCRIPTION: MCC LAYOUT

INSTALLATION: 10_PLC

PAGE: 17 OF 17

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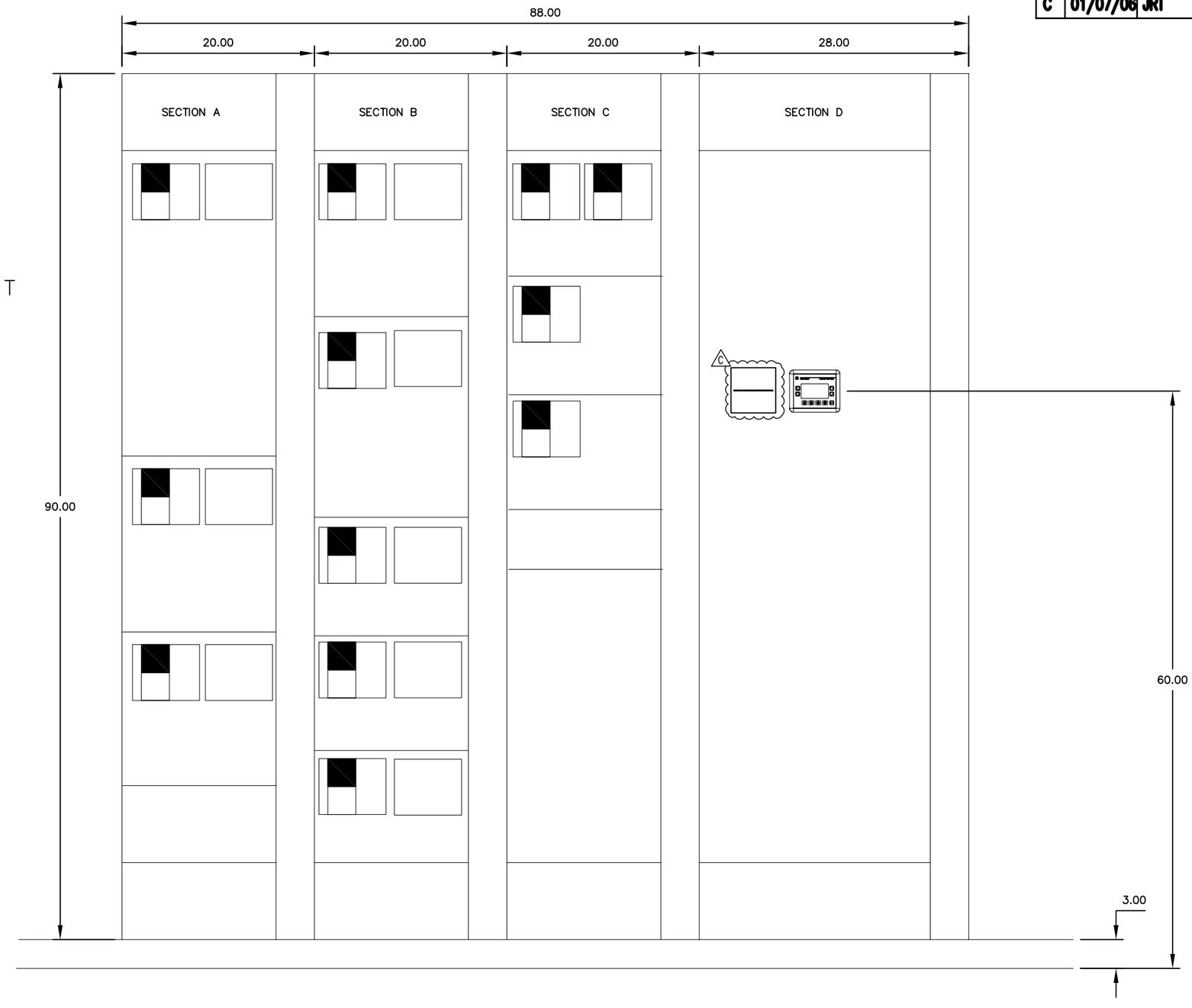
|---|---|---|---|
| A | 08/08/05 | KRW | SHOP RELEASE |
| B | 11/29/05 | KRW | FINAL AS BUILT |
| C | 01/07/06 | JRT | SYSTEM MODIFICATIONS BY CH2M.HILL |

SEE MCC MANUFACTURER LAYOUT
FOR BUCKET DETAILS




| | NAME | DATE |
|---|---|---|
| DRAWN | KRW | 07/08/05 |
| CKD | CDR | 08/08/05 |
| APPR | | |

REYNOLDS / ALCOA INC.
**FOCUSED EXTRACTION / PRODUCTION WELL OPTIMIZATION SYSTEM**
**TROUTDALE, OREGON**

PROJECT: 05-3853_ALCOA FE/PWO SYSTEM

DRAWING-NO: 05-3853-E Rev Level: B

JOB-NO: 05-3853

PAGE DESCRIPTION: MCC LAYOUT

INSTALLATION: 10_PLC

PAGE: 17 OF 17

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TETRA TECH EC, INC.

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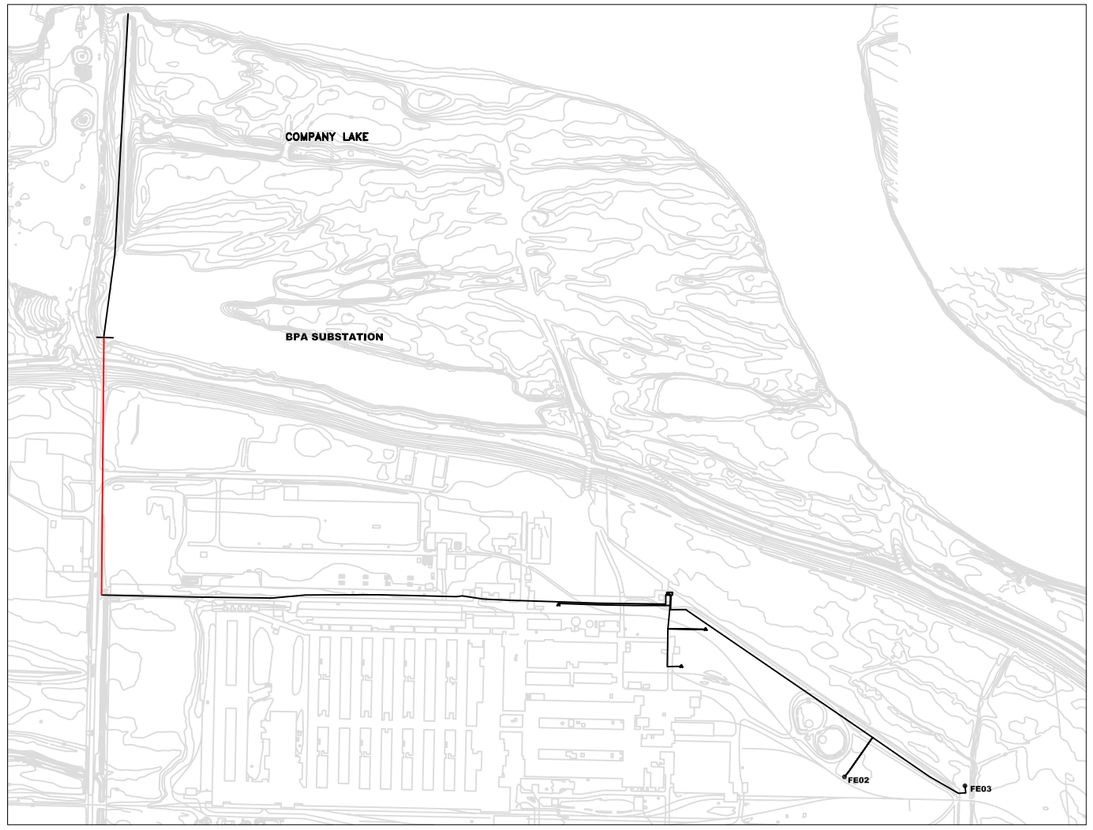
# REYNOLDS METALS COMPANY / ALCOA, INC
# FE/PWO SYSTEM
# TROUTDALE, OREGON




1/600XP

**PROJECT LOCATION MAP**

REGISTERED PROFESSIONAL ENGINEER
62607PE
OREGON
NOVEMBER 9,1999
TIMOTHY G. YAMADA
EXPIRES: 6/30/2006

## INDEX TO DRAWINGS


| SHEET | DWG NO. | DWG NAME |
|---|---|---|
| 1. | C-1 | TITLE PAGE |
| 2. | C-2 | SITE LAYOUT OF PIPING ALIGNMENT |
| 3. | C-3 | NEW PIPE ALIGNMENT LAYOUT |
| 4. | C-4 | DETAIL SHEET - PIPING - BUILDING 70 |
| 5. | C-5 | TRENCH SYSTEM AND DETAILS |
| 6. | C-6 | DETAIL SHEET- PIPING - AC/TRANSITE PIPE CONNECTION |
| 7. | C-7 | DETAIL SHEET - SAMPLE DISCHARGE BASIN DETAIL |
| 8. | E-1 | ELECTRICAL SYMBOL LEGEND |
| 9. | E-2 | ELECTRICAL ABBREVIATIONS |
| 10. | E-3 | ELECTRICAL - MCC ONE-LINE DIAGRAM |
| 11. | E-4 | ELECTRICAL ELEMENTARY DIAGRAMS |
| 12. | E-5 | ELECTRICAL PLAN |
| 13. | P-1 | PROCESS AND INSTRUMENTATION - LEGEND |
| 14. | P-2 | PROCESS AND INSTRUMENTATION - SYMBOL LEGEND |
| 15. | P-3 | PROCESS AND INSTRUMENTATION DIAGRAM - FE WELLS AND PRODUCTION WELLS |
| 16. | P-4 | PROCESS AND INSTRUMENTATION SAMPLE DISCHARGE BASIN |



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| 2 | 4/20/05 | REISSUED FOR BID | TY | |
| 1 | 4/8/05 | ISSUED FOR BID | TY | |
| 0 | 3/9/05 | ISSUED FOR CONSTRUCTION | SB | TY |

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REYNOLDS METALS COMPANY/ ALCOA, INC
FOCUSED EXTRACTION/PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
PIPING ALIGNMENT AND SITE LAYOUT
TITLE PAGE

| | |
|---|---|
| SHEET | 1 |
| DWG | C-1 |
| DATE | MARCH 2005 |
| PROJ | 166034 |

\\ROSA\PROJ\ALCOA\166034\CAD\JAN05NEW

FILENAME: C1.dwg PLOT DATE: 17-Oct-2006 PLOT TIME: 12:36pm

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COLUMBIA RIVER

SANDY RIVER

## LEGEND

- PRODUCTION WELL LOCATION
- FOCUSED EXTRACTION WELL LOCATION
- PROPOSED NEW PIPING ALIGNMENT
- EXISTING 16" UNDERGROUND TRANSITE PIPING
- EXISTING 16" ABOVEGROUND HDPE PIPING
- (1) AC/TRANSITE PIPE CONNECT, SEE DWG C-6 FOR DETAILS
- (2) FOCUSED EXTRACTION WELL PUMP DISCHARGE PIPING, SEE DETAIL 3 / C-5

GENERAL NOTE

1. EXISTING UNDERGROUND PIPING, NOT USED, SHALL BE DISPOSED OF OFF-SITE BY ALCOA DEMOLITION CONTRACTOR. EXISTING ABOVE GROUND PIPING AND APPURTENANCES, NOT USED, SHALL BE DISPOSED OF OFF-SITE, BY THIS CONTRACT.

FOR RESTRAINED JOINT REQUIREMENTS IN THIS AREA, SEE DWG C-4

RESTRAINED JOINTS
39° DEFLECTION
20'
20'
4"
8"
20'
NTS

3

8" PVC- ± 566'
TYPE 2 TRENCH
MULTIPLE PIPE TRENCH SECTION DETAIL 4 / C-5

12" PVC- ± 2765'
TYPE 2 TRENCH

1

FIELD ROUTE BETWEEN ROAD AND BPA FENCE LINE

PW05
SEE DWG C-3
PW03
PW08
PW07

8" PVC- ± 335'
TYPE 2 TRENCH
DETAIL 4 / C-5

RESTRAINED JOINTS
20'
20'
NTS

8" PVC- ± 118'
TYPE 2 TRENCH
DETAIL 4 / C-5

4" PVC- ± 290'
TYPE 1 TRENCH
DETAIL 4 / C-5

4" PVC- ± 1025'
TYPE 1 TRENCH
DETAIL 4 / C-5

4" PVC- ± 683'
TYPE 1 TRENCH
DETAIL 4 / C-5

FE02
2
FE03
2

RESTRAINED JOINTS
20'
20'
20'
±34.5° DEFLECTION
NTS

FE03
20'
±34.5° DEFLECTION
RESTRAINED JOINTS
NTS

N

0 500 1000

REGISTERED PROFESSIONAL ENGINEER
62607PE
OREGON
NOVEMBER 9,1999
TIMOTHY G. YAMADA
EXPIRES: 6/30/2006

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REYNOLDS METAL COMPANY / ALCOA, INC
FOCUSED EXTRACTION/PRODUCTION WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
PIPING ALIGNMENT AND SITE LAYOUT
SITE LAYOUT OF PIPING ALIGNMENT

SHEET 2
DWG C-2
DATE MARCH 2005
PROJ 166034

\\ROSA\PROJ\ALCOA\166034\CAD\JAN05NEW

FILENAME: C2.dwg PLOT DATE: 17-Oct-2006 PLOT TIME: 12:38pm

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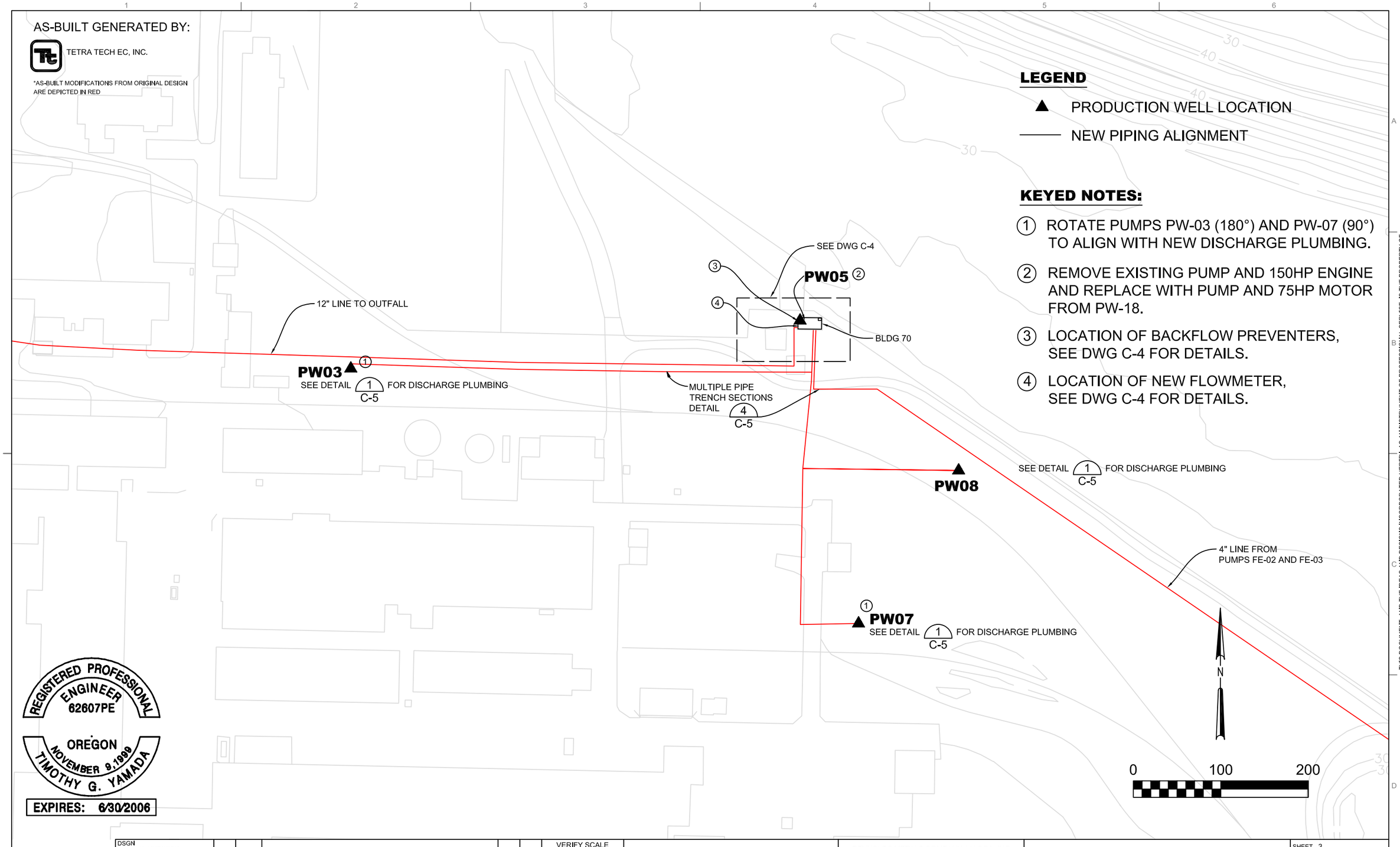


## LEGEND

- ▲ PRODUCTION WELL LOCATION
- —— NEW PIPING ALIGNMENT

## KEYED NOTES:

1. ROTATE PUMPS PW-03 (180°) AND PW-07 (90°) TO ALIGN WITH NEW DISCHARGE PLUMBING.
2. REMOVE EXISTING PUMP AND 150HP ENGINE AND REPLACE WITH PUMP AND 75HP MOTOR FROM PW-18.
3. LOCATION OF BACKFLOW PREVENTERS, SEE DWG C-4 FOR DETAILS.
4. LOCATION OF NEW FLOWMETER, SEE DWG C-4 FOR DETAILS.

REGISTERED PROFESSIONAL ENGINEER
62607PE
OREGON
NOVEMBER 9,1999
TIMOTHY G. YAMADA
EXPIRES: 6/30/2006

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| 1 | 4/8/05 | ISSUED FOR BID | TY | |
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DR C. JOLE
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FOCUSED EXTRACTION/PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
PIPING ALIGNMENT AND SITE LAYOUT
NEW PIPE ALIGNMENT LAYOUT

SHEET 3
DWG C-3
DATE MARCH 2005
PROJ 166034

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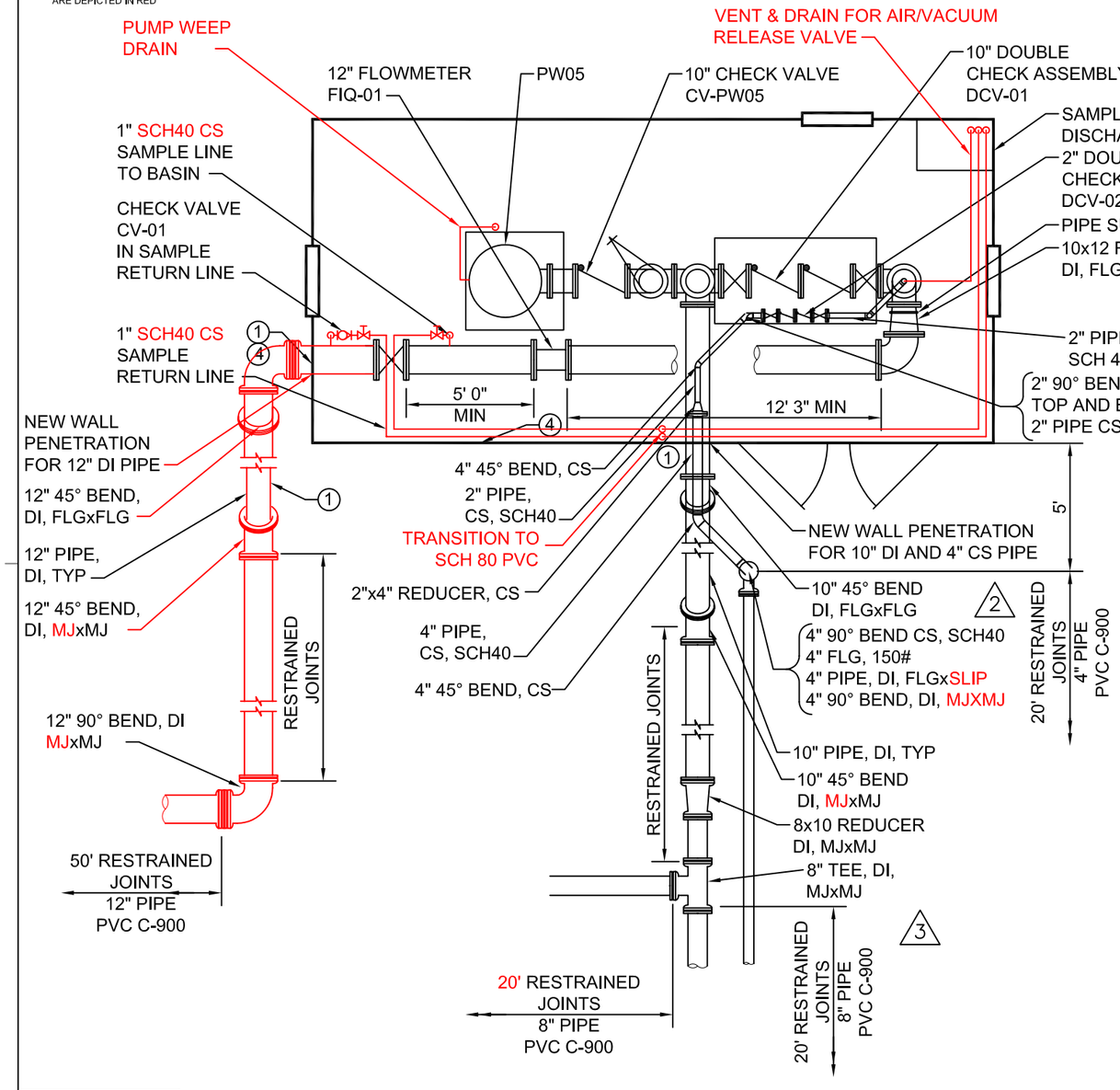
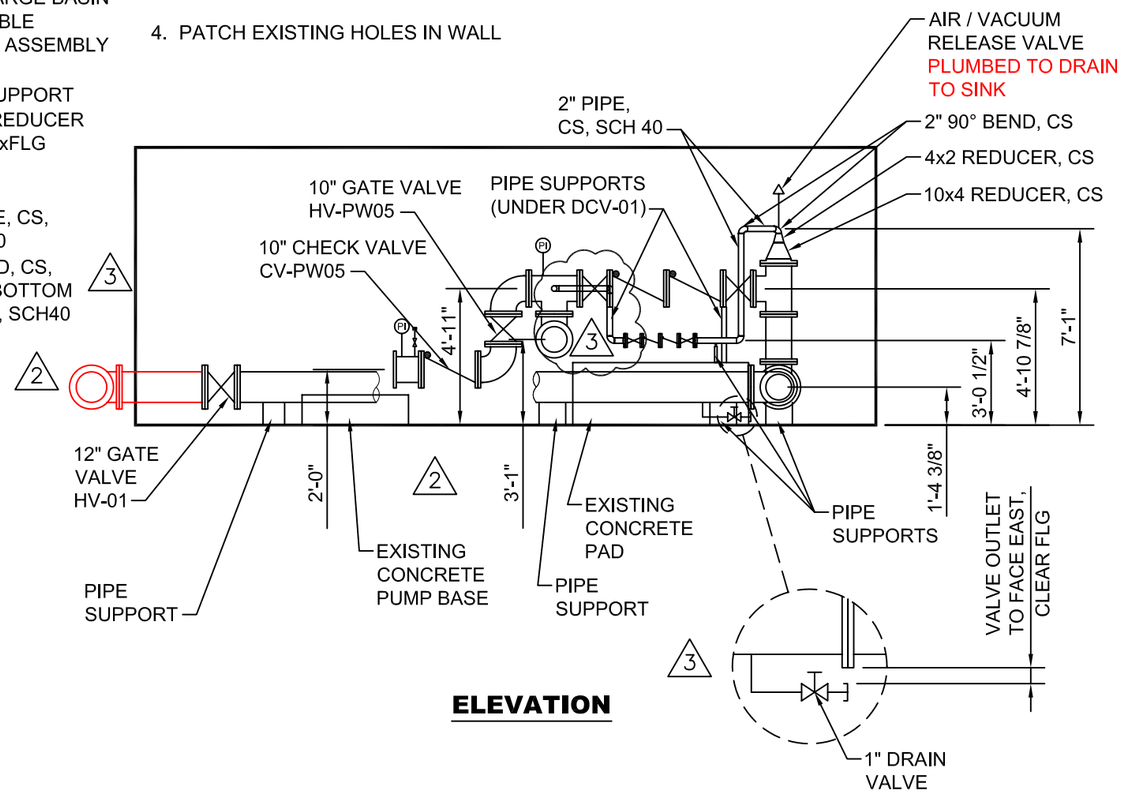

PUMP WEEP DRAIN
VENT & DRAIN FOR AIR/VACUUM RELEASE VALVE
12" FLOWMETER FIQ-01
PW05
10" CHECK VALVE CV-PW05
10" DOUBLE CHECK ASSEMBLY DCV-01
SAMPLE DISCHARGE BASIN
2" DOUBLE CHECK ASSEMBLY DCV-02
PIPE SUPPORT
10x12 REDUCER DI, FLGxFLG
1" SCH40 CS SAMPLE LINE TO BASIN
CHECK VALVE CV-01 IN SAMPLE RETURN LINE
1" SCH40 CS SAMPLE RETURN LINE
2" PIPE, CS, SCH 40
2" 90° BEND, CS, TOP AND BOTTOM 2" PIPE CS, SCH40
5' 0" MIN
12' 3" MIN
NEW WALL PENETRATION FOR 12" DI PIPE
12" 45° BEND, DI, FLGxFLG
12" PIPE, DI, TYP
12" 45° BEND, DI, MJxMJ
4" 45° BEND, CS
2" PIPE, CS, SCH40
TRANSITION TO SCH 80 PVC
2"x4" REDUCER, CS
4" PIPE, CS, SCH40
4" 45° BEND, CS
NEW WALL PENETRATION FOR 10" DI AND 4" CS PIPE
10" 45° BEND DI, FLGxFLG
4" 90° BEND CS, SCH40
4" FLG, 150#
4" PIPE, DI, FLGxSLIP
4" 90° BEND, DI, MJXMJ
5'
RESTRAINED JOINTS
20' RESTRAINED JOINTS 4" PIPE PVC C-900
RESTRAINED JOINTS
12" 90° BEND, DI MJxMJ
50' RESTRAINED JOINTS 12" PIPE PVC C-900
10" PIPE, DI, TYP
10" 45° BEND DI, MJxMJ
8x10 REDUCER DI, MJxMJ
8" TEE, DI, MJxMJ
20' RESTRAINED JOINTS 8" PIPE PVC C-900
20' RESTRAINED JOINTS
8" PIPE
PVC C-900

**BLDG 70 PIPING PLAN**

## NOTES:

1. ALL EXTERIOR ABOVE GROUND PIPE SHALL BE HEAT TRACED AND INSULATED. INSULATION AND JACKET SHALL EXTEND BELOW GROUND TO FIRST BURIED BEND.
2. CONTRACTOR TO REMOVE PAINT FLAKES ON ALL WALLS, CEILING, AND FLOOR. ASSUME PAINT CONTAINS LEAD.
3. CONTRACTOR TO REMOVE ALL EXISTING ABOVE GROUND INTERIOR AND EXTERIOR PIPE. ASSUME ALL EXISTING GASKETS ARE ACM.
4. PATCH EXISTING HOLES IN WALL




**ELEVATION**

REGISTERED PROFESSIONAL ENGINEER
62607PE
OREGON
November 9, 1999
TIMOTHY G. YAMADA
EXPIRES: 06-30-06

| NO. | DATE | REVISION | BY | APVD |
|---|---|---|---|---|
| 3 | 4/22/05 | PIPE REVISIONS; REISSUED FOR BID | SB | TY |
| 2 | 4/19/05 | PIPE REVISIONS; REISSUED FOR BID | SB | TY |
| 1 | 4/8/05 | ISSUED FOR BID | SB | TY |
| 0 | 3/9/05 | ISSUED FOR CONSTRUCTION | SB | TY |

DSGN T. YAMADA
DR C. JOLE
CHK G. LINDGREN
APVD

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REYNOLDS METALS / ALCOA, INC
FOCUSED EXTRACTION/PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
PIPING ALIGNMENT AND SITE LAYOUT
DETAIL SHEET - PIPING - ACCESS VAULTS

SHEET 4
DWG C-4
DATE MARCH 2005
PROJ 166034

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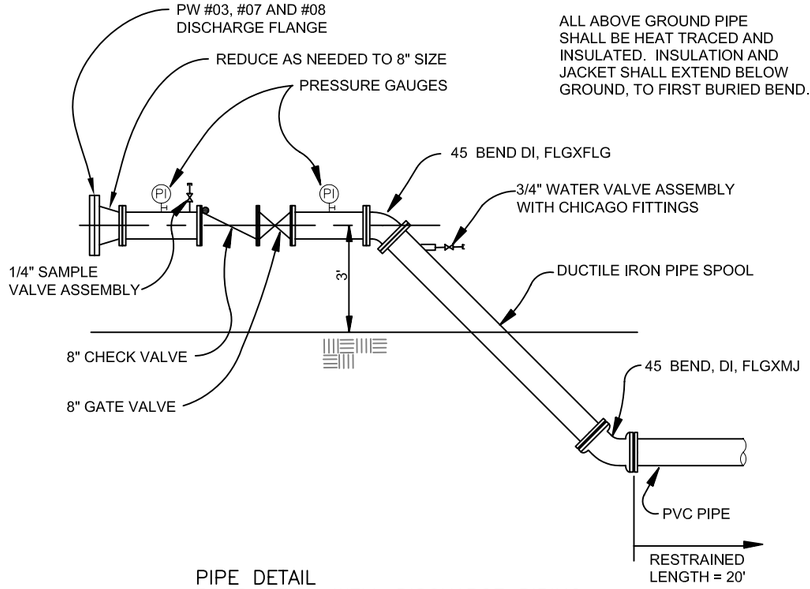
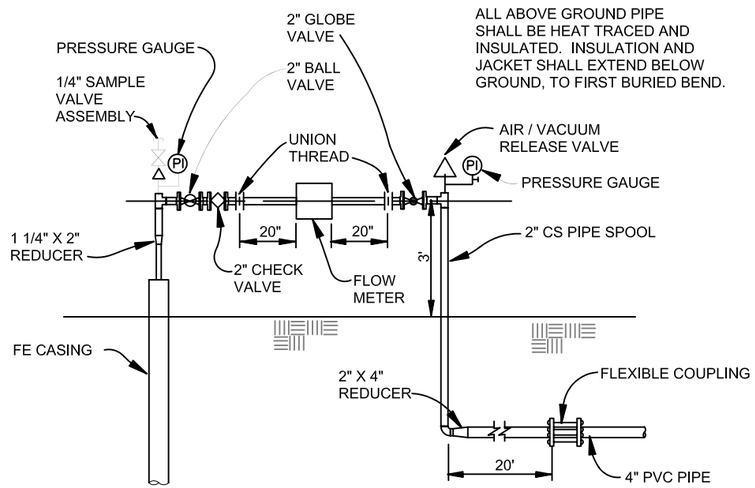

PW #03, #07 AND #08
DISCHARGE FLANGE
REDUCE AS NEEDED TO 8" SIZE
PRESSURE GAUGES
ALL ABOVE GROUND PIPE SHALL BE HEAT TRACED AND INSULATED. INSULATION AND JACKET SHALL EXTEND BELOW GROUND, TO FIRST BURIED BEND.
45 BEND DI, FLGXFLG
3/4" WATER VALVE ASSEMBLY WITH CHICAGO FITTINGS
1/4" SAMPLE VALVE ASSEMBLY
3'
DUCTILE IRON PIPE SPOOL
8" CHECK VALVE
8" GATE VALVE
45 BEND, DI, FLGXMJ
PVC PIPE
RESTRAINED LENGTH = 20'

PIPE DETAIL
PRODUCTION WELL DISCHARGE PIPING
PW–03, 07, 08

NTS — 1 / C-3




FOCUSED EXTRACTION WELL
DISCHARGING PIPING

NTS — 3 / C-2

1

SECTION 2 DELETED
FROM REV. 0
REF DWG C-4

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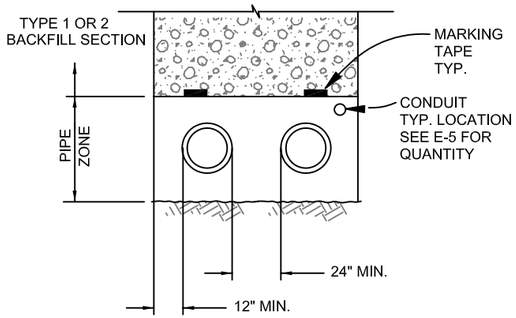
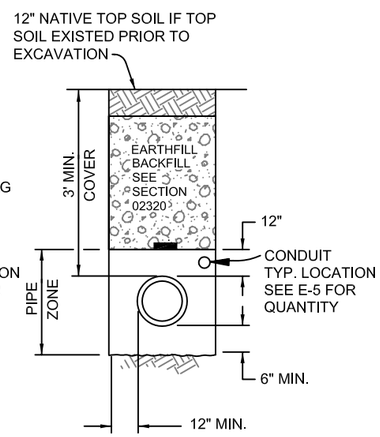
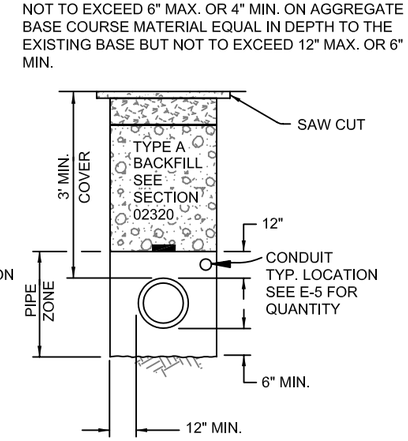
62607PE
OREGON
NOVEMBER 9, 1999
TIMOTHY G. YAMADA
EXPIRES: 6/30/2006




MULTI-PIPE TRENCH


12" NATIVE TOP SOIL IF TOP SOIL EXISTED PRIOR TO EXCAVATION
3' MIN. COVER
EARTHFILL BACKFILL SEE SECTION 02320
12"
CONDUIT TYP. LOCATION SEE E-5 FOR QUANTITY
PIPE ZONE
6" MIN.
12" MIN.

TYPE 1
UNIMPROVED AREAS


WHEN NOT OTHERWISE SPECIFIED, RESURFACING SHALL BE CRUSHED GRAVEL EQUAL IN DEPTH TO THE EXISTING NOT TO EXCEED 6" MAX. OR 4" MIN. ON AGGREGATE BASE COURSE MATERIAL EQUAL IN DEPTH TO THE EXISTING BASE BUT NOT TO EXCEED 12" MAX. OR 6" MIN.
SAW CUT
3' MIN. COVER
TYPE A BACKFILL SEE SECTION 02320
12"
CONDUIT TYP. LOCATION SEE E-5 FOR QUANTITY
PIPE ZONE
6" MIN.
12" MIN.

NOTE:
FOR PIPE ZONE BEDDING, BACKFILL AND COMPACTION REQUIREMENTS, SEE SECTION 02320 TRENCH BACKFILL

TYPE 2
CRUSHED GRAVEL
SURFACE

TYPICAL TRENCH SECTIONS
BACKFILL & SURFACING

NTS — 4 / C-2, C-3

AS-BUILT GENERATED BY:

TETRA TECH EC, INC.

*AS-BUILT MODIFICATIONS FROM ORIGINAL DESIGN ARE DEPICTED IN RED

| | | | | | | |
|---|---|---|---|---|---|---|
| DSGN T. YAMADA | 2 | 4/20/05 | REISSUED FOR BID | | TY | VERIFY SCALE: BAR IS ONE HALF INCH ON ORIGINAL DRAWING. 0 ▬▬▬ 1/2" IF NOT ONE HALF INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY. |
| DR C. JOLE | 1 | 4/8/05 | ISSUED FOR BID | | TY | |
| CHK T. YAMADA | 0 | 3/9/05 | ISSUED FOR CONSTRUCTION | SB | TY | |
| APVD | NO. | DATE | REVISION | BY | APVD | |

CH2MHILL

REYNOLDS METALS / ALCOA, INC
FOCUSED EXTRACTION/PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
PIPING ALIGNMENT AND SITE LAYOUT
TRENCH SYSTEM AND DETAILS

SHEET 5
DWG C-5
DATE MARCH 2005
PROJ 166034

\\ROSA\PROJ\ALCOA\166034\CAD\JAN05NEW

FILENAME: C5.dwg PLOT DATE: 17-Oct-2006 PLOT TIME: 12:43pm

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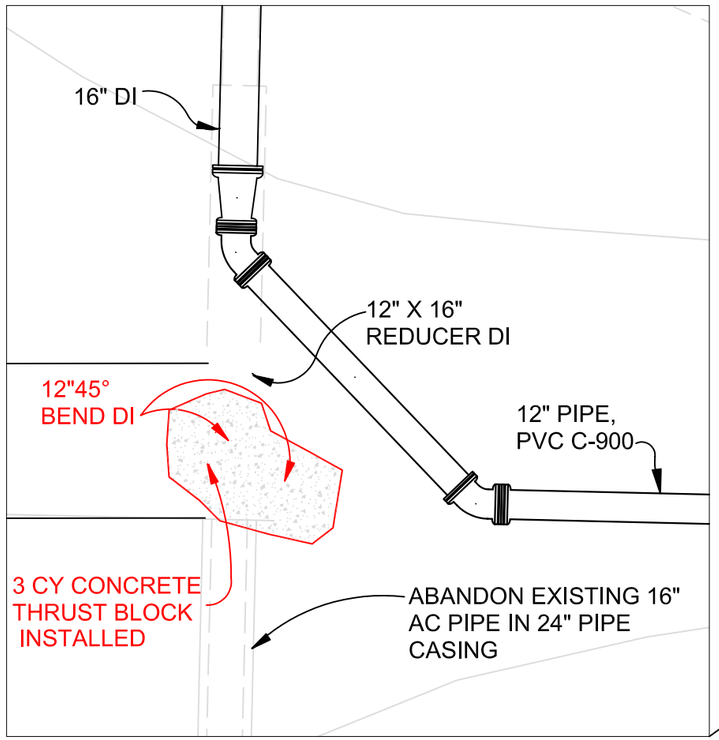
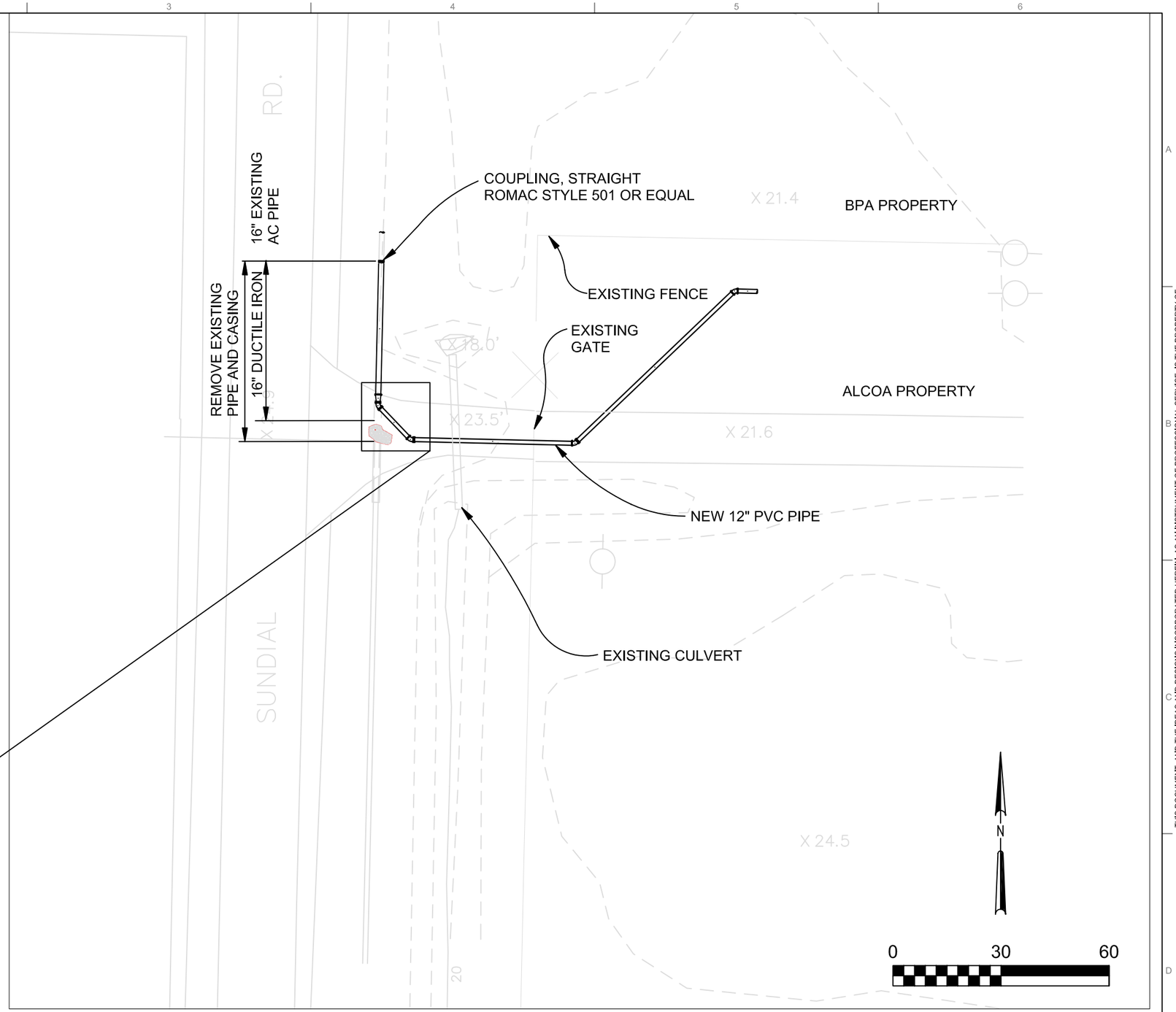

16" DI
12" X 16" REDUCER DI
12"45° BEND DI
12" PIPE, PVC C-900
3 CY CONCRETE THRUST BLOCK INSTALLED
ABANDON EXISTING 16" AC PIPE IN 24" PIPE CASING

NTS




REGISTERED PROFESSIONAL ENGINEER
62607PE
OREGON
NOVEMBER 9,1999
TIMOTHY G. YAMADA
EXPIRES: 6/30/2006

| NO. | DATE | REVISION | BY | APVD |
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| 2 | 4/20/05 | REISSUED FOR BID | | TY |
| 1 | 4/8/05 | ISSUED FOR BID | | TY |
| 0 | 3/9/05 | ISSUED FOR CONSTRUCTION | SB | TY |

DSGN T. YAMADA
DR C. JOLE
CHK
APVD

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REYNOLDS METALS / ALCOA, INC
FOCUSED EXTRACTION/PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
PIPING ALIGNMENT AND SITE LAYOUT
AC/TRANSITE PIPE CONNECTION DETAIL

SHEET 6
DWG C-6
DATE MARCH 2005
PROJ 166034

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FILENAME: C6.dwg PLOT DATE: 17-Oct-2006 PLOT TIME: 12:46pm


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# SYMBOLS

CONDUCTOR GROUND
CONDUCTOR, HOT
CONDUCTOR, NEUTRAL
CONDUCTOR SWITCHED OR LIGHTING
CONDUIT DOWN
CONDUIT UP
CONDUIT WITH PULL WIRE, STUBBED AND CAPPED
GROUND ROD
FLEXIBLE CONDUIT
HOMERUN, 1 CIRCUIT
HOMERUN, 2 CIRCUITS
HOMERUN, 3 CIRCUITS
JUNCTION BOX
FLOOR MOUNTED JUNCTION BOX
WALL MOUNTED JUNCTION BOX
PULL BOX
SPECIAL PURPOSE RECEPTACLE NEMA CONFIGURATION (L5-30)
WALL MOUNTED RECEPTACLE, DUPLEX
GFI = GROUND FAULT INTERRUPT
WP = WEATHERPROOF IC = ISOLATED GROUND
YYY = CIRCUIT NUMBER
WALL MOUNTED RECEPTACLE, 4-PLEX
GFI = GROUND FAULT INTERRUPT
WP = WEATHERPROOF IC = ISOLATED GROUND
YYY = CIRCUIT NUMBER
TELEPHONE RECEPTACLE, WALL MOUNTED
WP = WEATHERPROOF
DATA RECEPTACLE, WALL MOUNTED
MOTOR
HP = HORSEPOWER
F = FRACTIONAL (1/3 HP OR LESS)
EMERGENCY ENGINE GENERATOR
CIRCUIT BREAKER
A = AMPERAGE
PUSH BUTTON OR CONTROL STATION WITH DEVICE TAG NUMBER
EMO = EMERGENCY OFF
GROUNDING BUS, GROUND PLATE
DRIVEN GROUND ROD
GROUNDING EXOTHERMIC WELD CONNECTION
TRIANGULAR GROUND ROD ASSEMBLY
#4/0 BARE COPPER PIGTAIL
GROUND ROD WITH INSPECTION WELL
THERMOSTAT
VARIABLE FREQUENCY DRIVE
CONNECTION POINT TO EQUIPMENT SPECIFIED, SUPPLIED AND INSTALLED UNDER OTHER DIVISIONS. RACEWAY, CONDUCTORS AND CONNECTIONS UNDER THIS DIVISION.

120V SURFACE MOUNTED PANEL BOARD (WITH IDENTIFIER)
120V FLUSH MOUNTED PANEL BOARD (WITH IDENTIFIER)
480V SURFACE MOUNTED PANEL BOARD (WITH IDENTIFIER)
480V FLUSH MOUNTED PANEL BOARD (WITH IDENTIFIER)
NONFUSED DISCONNECT SWITCH
Y = AMPERAGE INDICATED
FUSED DISCONNECT SWITCH
X = FUSE AMPERAGE
Y = SWITCH AMPERAGE
ENCLOSED MAGNETIC CONTACTOR
X = AMPERAGE INDICATED
ENCLOSED MAGNETIC STARTER
X = NEMA SIZE INDICATED
ENCLOSED COMBINATION MAGNETIC STARTER
X = NEMA SIZE INDICATED
PHOTOELECTRIC LIGHTING CONTROL UNIT
SENSOR AIMED NORTH ULESS OTHERWISE NOTED
VOLUME CONTROL SWITCH
CONE TYPE SPEAKER, CEILING SURFACE MOUNTED
CONE TYPE SPEAKER, WALL SURFACE MOUNTED
ELECTRIC STRIKE
RELAY
HANDHOLE
HANDHOLE WITH ID NUMBER
MANHOLE
MANHOLE WITH ID NUMBER
INDICATING LIGHT, PUSH-TO-TEST
LETTER INDICATES COLOR
LIGHT, CEILING MOUNTED
LIGHT (LAMP, STROBE) LETTER INDICATES COLOR
AMBER
BLUE
GREEN
RED
WHITE
YELLOW
HIGH INTENSITY LEVEL
MEDIUM INTENSITY LEVEL
LOW INTENSITY LEVEL
POWER MONITOR

LIGHTING DESIGNATIONS:
A1 = LUMINAIRE TYPE
1 = CIRCUIT NUMBER
a = SWITCH LEG DESIGNATION
EM = EMERGENCY
HD = HIGH INTENSITY DISCHARGE
V = INVERTER

FLUORESCENT LIGHT FIXTURE, SURFACE/RECESS MOUNT
EMERGENCY LIGHT FIXTURE OR INVERTER
EM = EMERGENCY
V = INVERTER
BATTERY OPERATED EMERGENCY LIGHT, 2 LAMPS
INVERTER SYSTEM EMERGENCY LIGHT
FLUORESCENT STRIP LIGHT
FLUORESCENT STRIP LIGHT-EMERGENCY
TEARDROP LIGHT FIXTURE
SURFACE MOUNTED LIGHT
RECESSED LIGHT
WALL MOUNTED LIGHT
POLE MOUNTED LIGHT
EXIT LIGHT, CEILING MOUNTED
EXIT LIGHT, WALL MOUNTED
INDICATES EXIT PATH FOR EXIT LIGHT
WALL SWITCH, SUBSCRIPT INDICATES TYPE:
2 = DOUBLE POLE
3 = THREE WAY
4 = FOUR WAY
D = DIMMER
M = MANUAL MOTOR STARTER SWITCH
LV = LOW VOLTAGE
P = PILOT LIGHT
K = KEY OPERATED
WP = WEATHERPROOF
T = THERMAL SWITCH
WALL SWITCH, PUSHBUTTON

METER w/SWITCH, AMMETER
METER w/SWITCH, VOLTMETER
TRANSFORMER, KVA, PRIMARY AND SECONDARY VOLTAGE INDICATED
ISOLATION TRANSFORMER, KVA, PRIMARY AND SECONDARY VOLTAGE INDICATED
CONTROL TRANSFORMER, PRIMARY AND SECONDARY VOLTAGE INDICATED
INSTRUMENTATION CONTROL TRANSFORMER, RATIO, QUANTITY AND CONNECTION INDICATED
CURRENT TRANSFORMER, QUANTITY AND RATIO INDICATED
AUTOMATIC TRANSFER SWITCH, CONTINUOUS CURRENT RATING AS INDICATED
GROUND FAULT INTERRUPTER
GROUND
SURGE, LIGHTNING ARRESTOR
CIRCUIT BREAKER, MAGNETIC TRIP ONLY
CIRCUIT BREAKER, THERMAL MAGNETIC OR SOLID STATE TRIP OR TRIP/FRAME SHOWN
CIRCUIT BREAKER, LOW VOLTAGE, DRAW OUT
CIRCUIT BREAKER, MEDIUM VOLTAGE, DRAW OUT
IN-LINE FUSE
FUSE, CURRENT RATING INDICATED
FUSED SWITCH, CURRENT RATING INDICATED
SWITCH, CURRENT RATING INDICATED
ELECTRIC DOOR INTERLOCK

CONTACTS, N.O.
CONTACTS, N.C.
OVERLOAD
SELECTOR SWITCH, MAINTAINED CONTACT
X = CLOSED CONTACT
O = OPEN CONTACT
SELECTOR SWITCH, MAINTAINED CONTACT
X = CLOSED CONTACT
O = OPEN CONTACT
REMOTE CONTACT, N.O.
END OF LINE DEVICE
CLOCK
DOOR STATUS SWITCH
ACCESS CONTROL LOCAL ALARM HORN
CARD READER
CARD READER WITH KEYPAD
MDA ANNUNCIATOR
MOTION SENSOR
P = PIR
M = MICROWAVE
G = GROUP SENSOR
PRX = PROXIMITY SENSOR
EVACUATION SPEAKER
S = SURFACE MOUNTED
Z = ZONE
Y = DEVICE NUMBER
F = FLUSH MOUNTED
EVACUATION SPEAKER, WALL MOUNTED
X = ALARM TYPE Y = MOUNTING
F = FIRE ALARM F = FLUSH MOUNTED
H = HPM ALARM S = SURFACE MOUNTED
L = LOUD SPEAKER TYPE
EVACUATION SPEAKER w/STROBE, WALL MOUNTED (WHITE STROBE = FIRE, BLUE STROBE = HPM)
EVACUATION SPEAKER w/STROBE, WALL MOUNTED
EVACUATION STROBE
VALVE TAMPER SWITCH (FIRE PROTECTION, EMERGENCY EYEWASH/SHOWER)
VALVE FLOW SWITCH (FIRE PROTECTION, EMERGENCY EYEWASH/SHOWER)
HEAT DETECTOR
F = FIXED TEMPERATURES
R = RATE OF RISE
R/C = RATE COMPENSATED
R/F = COMBINATION
SMOKE DETECTOR
BT = BEAM TRANSMITTER P = PHOTOELECTRIC
BR = BEAM RECEIVER J = IONIZATION
E = INSTALLED IN EQUIPMENT

SMOKE DETECTOR IN DUCT
GAS DETECTION SENSOR (SAMPLE) PORT
H2 DETECTOR, X = SCHEDULED
EMERGENCY TELEPHONE STATION
C = CONTROL MODULE
M = MONITOR MODULE
R = RELAY MODULE
S = SUPERVISORY MODULE
MANUAL SMOKE PURGE CONTROL
POST INDICATOR VALVE
LIFE SAFETY CONTROL PANEL, SURFACE MOUNTED
LIFE SAFETY CONTROL PANEL, FLUSH MOUNTED
END OF LINE DEVICE
ENLARGED AREA, SCOPE OF WORK
REVISION CLOUD
CONDUIT AND CONDUCTORS ABOVE GRADE CONCEALED IN WALL OR CEILING
CONDUIT AND CONDUCTORS BELOW GRADE OR SLAB
CONDUIT AND CONDUCTORS, CONDUIT EXPOSED
P — PRIMARY VOLTAGE SYSTEM
D — DATA CONDUIT AND CABLES
EM — EMERGENCY POWER SYSTEM WIRING AND EMERGENCY CONDUIT
EST — EST CONDUIT AND CABLES
G — GROUNDING CONDUCTOR
IG — ISOLATED GROUND CONDUCTOR
MDA — MDA SYSTEM CONDUIT
LLD — LIQUID LEAK DETECTION
T — TELEPHONE
FMS — FACILITIES MANAGEMENT (OR MONITORING) SYSTEM
CCTV — CLOSED CIRCUIT TELEVISION CONDUIT
MAJOR ELECTRICAL COMPONENT OR DEVICE
CHANGE IN ELEVATION USING VERTICAL ADJUSTABLE SIDE PLATES
CONDUIT ROUTING ZONE
WIREWAY, SIZE AS INDICATED
BUSWAY-FEEDER OR PLUG-IN AS INDICATED ON ONE-LINE, DEVICE TYPE AND RATING INDICATED
NO CONNECTION
CONNECTION AS INDICATED

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REYNOLDS METALS COMPANY / ALCOA, INC
FOCUSED EXTRACTION/PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
ELECTRICAL
SYMBOL LEGEND

SHEET 1
DWG E-1
DATE 02/22/05
PROJ 166034

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FILENAME: E1.dwg PLOT DATE: 17-Oct-2006 PLOT TIME: 9:59am

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# ABBREVIATIONS

| ABBREVIATIONS | DESCRIPTION |
|---|---|
| A, AMP | AMMETER, AMPERE |
| AB | ABSOLUTE |
| AC | ALTERNATING CURRENT |
| ACB | AIR CIRCUIT BREAKER |
| AF | AMPERE FRAME |
| AFD | ADJUSTABLE FREQUENCY DRIVE |
| AFF | ABOVE FINISHED FLOOR |
| AIC | AMPS INTERRUPTING CURRENT |
| ANN | ANNUNCIATOR |
| ARF | ABOVE RAISED FLOOR |
| AS | AMMETER SWITCH |
| AT | AMP TRIP |
| ATS | AUTOMATIC TRANSFER SWITCH |
| ATX | AUTO TRANSFORMER |
| AWG | AMERICAN WIRE GAUGE |
| B | BELL |
| BC | BARE COPPER |
| BFF | BELOW FINISHED FLOOR |
| BG | BULK GAS |
| BKR | BREAKER |
| BLDG | BUILDING |
| BMS | BUILDING MANAGEMENT SYSTEM |
| BOC | BOTTOM OF CONDUIT |
| BOD | BOTTOM OF DUCT |
| BOP | BOTTOM OF PIPE |
| BOT | BOTTOM OF TRAY |
| BRN | BUS REFERENCE NO. (ENGINEERING STUDY USE) |
| BT | BASIC TRANSPONDER |
| C | CONDUIT, COIL |
| CAT. # | CATALOG NUMBER |
| CB | CIRCUIT BREAKER |
| CC | CONTROL CABLE |
| CCTV | CLOSED CIRCUIT TELEVISION |
| CKT | CIRCUIT |
| CLK | CLOCK |
| CMP | COMPRESSOR |
| CO | CONDUIT ONLY |
| CPT | CONTROL POWER TRANSFORMER |
| CR | CONTROL RELAY |
| CRE | CORROSION RESISTANT |
| CRS | COATED RIGID STEEL CONDUIT |
| CRWP | CLEANROOM WALL PANEL |
| CT | CURRENT TRANSFORMER |
| D | DUCT |
| DB | DUCT BANK |
| DC | DIRECT CURRENT |
| DDC | DIRECT DIGITAL CONTROL |
| DIA | DIAMETER |
| DIV | DIVISION |
| Δ | DELTA CONNECTED |
| DS | DISCONNECT SWITCH |
| E / I | ELECTRICALLY OPERATED AND INTERLOCKED |
| E | EMPTY |
| (E), EX | EXISTING |
| ECS | EMERGENCY COMMAND STATION |
| EDF | ELECTRIC DRINKING FOUNTAIN |
| EG | ENGINE GENERATOR |
| EL | ELEVATION |
| ELEC | ELECTRICAL |
| EM,EMER | EMERGENCY |
| EMH | ELECTRICAL MANHOLE |
| EMI | ELECTRO MAGNETIC INTERFERENCE |
| EMO | EMERGENCY MANUAL OFF |
| EMT | ELEC METALLIC TUBING |
| ENT | ELEC NON-METALLIC TUBING |
| EOL | END-OF-LINE DEVICE |
| ERT | EMERGENCY RESPONSE TEAM |
| ET | EXPANDED TRANSPONDER |
| ETM | ELAPSED TIME METER |
| EWC | ELECTRIC WATER COOLER |
| EXH | EXHAUST |
| F | FLUSH |
| FAS | FIRE ALARM SPEAKERS |
| (F) | FUTURE |
| FA | FIRE ALARM |
| FACP | FIRE ALARM CONTROL PANEL |
| FBO | FURNISHED BY OTHERS |
| FCS | FACILITY CONTROL SYSTEM |
| FDR | FEEDER |
| FLA | FULL LOAD AMPERES |
| FLR | FLOOR |
| FO | FIBER OPTIC |
| FOL | FAST ACTING OL RELAY |
| FU | FUSE |
| FWS | FIRE WATER STORAGE |
| FVNR | FULL VOLTAGE NON-REVERSING |
| FVR | FULL VOLTAGE REVERSING |
| (G),GND | GROUND |
| GEN | GENERAL |
| GFCI | GROUND FAULT CIRCUIT INTERRUPTER |
| GFR | GROUND FAULT RELAY |
| GSM | GAS SAFETY MONITOR |
| H | HORN |
| HH | HANDHOLE |
| HID | HIGH INTENSITY DISCHARGE |
| HOA | HAND-OFF-AUTOMATIC |
| HVAC | HEATING, VENTILATING & AIR CONDITIONING |
| HB | HORIZONTAL BEND |
| HP | HORSEPOWER |
| HZ | HERTZ (frequency) |
| ICCB | INSULATED CASE CIRCUIT BREAKER |
| I.D. | IDENTIFICATION |
| IER | INTEGRATED EQUIPMENT RATING |
| I&C | INSTRUMENTATION AND CONTROL |
| IMC | INTERMEDIATE METALLIC CONDUIT |
| I/O | INPUT/OUTPUT |
| IPS | INVERTER POWER SUPPLY |
| IS | CURRENT SWITCH |
| J, JB | JUNCTION BOX |
| K | KEY INTERLOCK |
| KAIC | KILOAMP INTERUPTING CAPACITY |
| KCMIL | 1000 CIRCULAR MIL |
| KVA | KILOVOLT-AMPERE |
| KVAR | KILOVAR |
| KW | KILOWATT |
| KWH | KILOWATT HOUR |
| L | LEFT |
| LAN | LOCAL AREA NETWORK |
| LC | LIGHTING CONTACTOR |
| LCP | LOCAL CONTROL PANEL |
| LTG | LIGHTING |
| LV | LOW VOLTAGE |
| M | MAG CONTACTOR, COIL OR CONTACT |
| MAX | MAXIMUM |
| MBS | MAINTENANCE BYPASS SWITCH |
| MCB | MAIN CIRCUIT BREAKER |
| MCC | MOTOR CONTROL CENTER |
| MCCB | MOLDED CASE CIRCUIT BREAKER |
| MCP | MOTOR CIRCUIT PROTECTOR |
| MDC | MOTORIZED DAMPER CONTROL |
| MFR | MANUFACTURER |
| MH | MANHOLE |
| MIN | MINIMUM |
| MLO | MAIN LUGS ONLY |
| MMP | MECHANICAL MOUNTING PANEL |
| MS | MOTOR STARTER |
| MSP | MOTOR STARTER PANEL |
| MT,MTD | MOUNT, MOUNTED |
| A-1,3,5 | TYPICAL HOMERUN DESIGNATION TO CIRCUITS 1,3,5 IN PANEL 'A' |
| A-(1,3,5) | TYPICAL HOMERUN DESIGNATION TO 3-POLE CIRCUIT BREAKER IN PANEL 'A' |
| (N) | NEW |
| N | NEUTRAL |
| NA | NON-AUTOMATIC |
| N.C. | NORMALLY CLOSED |
| N.E. | NORTH EAST |
| NEC | NATIONAL ELECTRICAL CODE |
| NEMA | NATIONAL ELECTRIC MANUFACTURERS ASSOCIATION |
| NIC | NOT IN CONTRACT |
| NL | NIGHT LIGHT |
| N.O. | NORMALLY OPEN |
| NP | NAMEPLATE |
| NTS | NOT TO SCALE |
| N.S. | NORTH SUPPORT |
| N.W. | NORTH WEST |
| OCB | 115KV OIL CIRCUIT BREAKER |
| OFCI | OWNER FURNISHED, CONTRACTOR INSTALLED |
| OFOI | OWNER FURNISHED, OWNER INSTALLED |
| OL | OVERLOAD RELAY |
| OO | ON-OFF |
| OOA | ON-OFF-AUTO |
| OOR | ON-OFF-REMOTE |
| OPD | OPEN POLE DETECTOR |
| P | POWER |
| PF | POWER FACTOR |
| PL | PILOT LIGHT |
| PB | PUSHBUTTON OR PULL BOX |
| PC | PHOTOCELL |
| PCP | PLANT CONTROL PANEL |
| PIN | PERSONAL ID NUMBER |
| PIV | POST INDICATOR VALVE |
| PMH | PRIMARY MANHOLE |
| PNL | PANEL |
| ?, PH | PHASE |
| PVC | POLYVINYL CHLORIDE |
| QTY | QUANTITY |
| R | RATE OF RISE, RIGHT |
| (R) | RELOCATE |
| RCPT | RECEPTACLE |
| RECEPT | RECEPTACLE |
| REPL | REPLACEMENT |
| RCY | RACEWAY |
| (RD) | REDUNDANT |
| RF | RADIO FREQUENCY |
| RM | ROOM |
| RMC | RIGID METAL CONDUIT |
| RMS | ROOT MEAN SQUARE |
| ROD | REQUIRED |
| RTM | RUNNING TIME METER |
| RUPS | ROTARY UNINTERUPTIBLE POWER SUPPLY |
| RVNR | REDUCED VOLTAGE NON-REVERSING |
| RVR | REDUCED VOLTAGE REVERSING |
| S | SPEAKER |
| S.C. | SHORT CIRCUIT |
| SCP | SECURITY CONTROL PANEL |
| S.E. | SOUTH EAST |
| SEC | SECONDS |
| SES | SERVICE ENTRANCE SUBSTATION |
| SFEP | SMOKE/FUME EXHAUST PANEL |
| SO | SWITCH OPERATOR |
| SOL | SLOW SPEED OL RELAY |
| SP | SPARE |
| SPKR | SPEAKER |
| SRP | SALT RIVER PROJECT UTILITY CO. |
| SS | STAINLESS STEEL |
| STC | SOURCE TRANSFER CONTROL |
| STD | STANDARD |
| STR | STARTER |
| SUPP | SUPPRESSOR |
| SUR | SURFACE |
| SW | SWITCH |
| S.W. | SOUTH WEST |
| SWBD | SWITCHBOARD |
| SWGR | SWITCHGEAR |
| SYM | SYMMETRICAL |
| SYNC | SYNCHRONIZER |
| TSTAT | THERMOSTAT |
| TB | TERMINAL BLOCK |
| TBD | TO BE DETERMINED |
| TC | TIME CLOCK |
| TDR | TIME DELAY RELAY |
| TJB | TERMINAL JUNCTION BOX |
| TMH | TELEPHONE MANHOLE |
| TS | TAMPER SWITCH |
| TSP | TWISTED SHIELDED PAIR |
| TYP | TYPICAL |
| UD | UTILITY DROP |
| UPS | UNINTERRUPTIBLE POWER SUPPLY |
| V | VOLTMETER, VOLT |
| VA | VOLT-AMPERE |
| VESDA | VERY EARLY SMOKE DETECTION APPARATUS |
| VFD | VARIABLE FREQUENCY DRIVE |
| VIB | VERTICAL INSIDE BEND |
| VLF | VERTICAL LAMINAR FLOW UNIT |
| VOB | VERTICAL OUTSIDE BEND |
| VP | VAPORPROOF |
| VPCI | VENDOR PROVIDED CONTRACTOR INSTALLED |
| VS | VOLTMETER SWITCH |
| VT | VOLTAGE TRANSFORMER |
| W | WATT, WIRE |
| WHD | WATTHOUR DEMAND METER |
| WP | WEATHERPROOF |
| WSPW | WAFER STARTS PER WEEK |
| X | EXPLOSION PROOF - TYPE, CLASS AND GROUP AS NOTED |
| (X) | REMOVE |
| XFMR | TRANSFORMER |
| Y | WYE-CONNECTED |
| Z | IMPEDANCE |
| 2S1W | TWO SPEED, ONE WINDING |
| 2S2W | TWO SPEED, TWO WINDING |

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DR C. ARNOLD
CHK G. LINDGREN
APVD H. AZARI

VERIFY SCALE
BAR IS ONE HALF INCH ON ORIGINAL DRAWING. IF NOT ONE HALF INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

REYNOLDS METALS COMPANY / ALCOA, INC
FOCUSED EXTRACTION/PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
ELECTRICAL ABBREVIATIONS

SHEET 2
DWG E-2
DATE 02/22/05
PROJ 166034

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FILENAME: E2.dwg PLOT DATE: 17-Oct-2006 PLOT TIME: 10:00am

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## KEYED NOTES

1 MCC MANUFACTURER TO PROVIDE INTEGRAL TRANSFORMER AND 24 CIRCUIT PANELBOARD AS SHOWN.

2 PROVIDE 30mA GFPE CIRCUIT BREAKER FOR HEAT TRACE CIRCUITS IN ACCORDANCE WITH NEC REQUIREMENTS.

3 REFER TO DRAWING E-4, DETAIL 1 FOR ELEMENTARY DIAGRAM.

4 REFER TO DRAWING E-4, DETAIL 2 FOR ELEMENTARY DIAGRAM.

5 REFER TO DRAWING E-4, DETAIL 3 FOR ELEMENTARY DIAGRAM.

6 REFER TO PLAN DRAWING E-5 FOR CONNECTION TO EXISTING UNDERGROUND

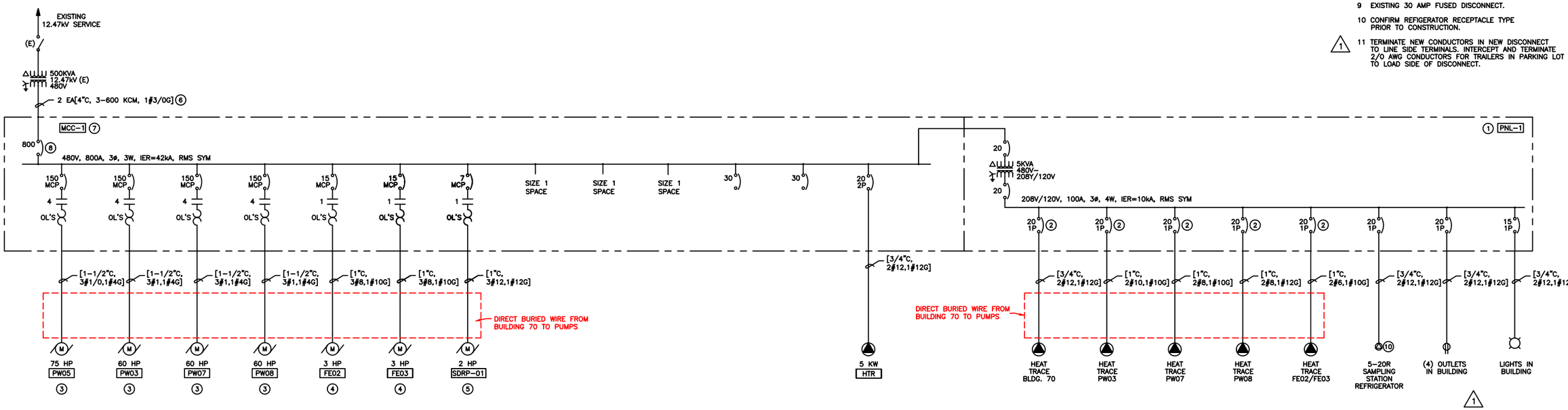
7 ALLEN-BRADLEY MICROLOGIX 1500 PLC TO BE PROVIDED AND INSTALLED INTEGRAL TO MCC BY MCC VENDOR. REFER TO SPECIFICATION FOR DESCRIPTION.

8 SERVICE ENTRANCE RATED BREAKER.

9 EXISTING 30 AMP FUSED DISCONNECT.

10 CONFIRM REFIGERATOR RECEPTACLE TYPE PRIOR TO CONSTRUCTION.

△1 11 TERMINATE NEW CONDUCTORS IN NEW DISCONNECT TO LINE SIDE TERMINALS. INTERCEPT AND TERMINATE 2/0 AWG CONDUCTORS FOR TRAILERS IN PARKING LOT TO LOAD SIDE OF DISCONNECT.




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DSGN J. HISER | | | | | | VERIFY SCALE | CH2MHILL |
| DR C. ARNOLD | | | | | | BAR IS ONE HALF INCH ON ORIGINAL DRAWING. 0 1/2" IF NOT ONE HALF INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY. | |
| CHK G. LINDGREN | 1 | 04/08/05 | ISSUED FOR CONSTRUCTION | DS | HA | | |
| APVD H. AZARI | 0 | 03/09/05 | ISSUED FOR CONSTRUCTION | JH | HA | | |
| | NO. | DATE | REVISION | BY | APVD | | |

REYNOLDS METALS COMPANY / ALCOA, INC
FOCUSED EXTRACTION/PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
ELECTRICAL
MCC ONE-LINE DIAGRAM

SHEET 10
DWG E-3
DATE 03/09/05
PROJ 166034

\\ROSA\PROJ\ALCOA\166034\CAD\JAN05NEW

FILENAME: E3.dwg PLOT DATE: 17-Oct-2006 PLOT TIME: 10:01am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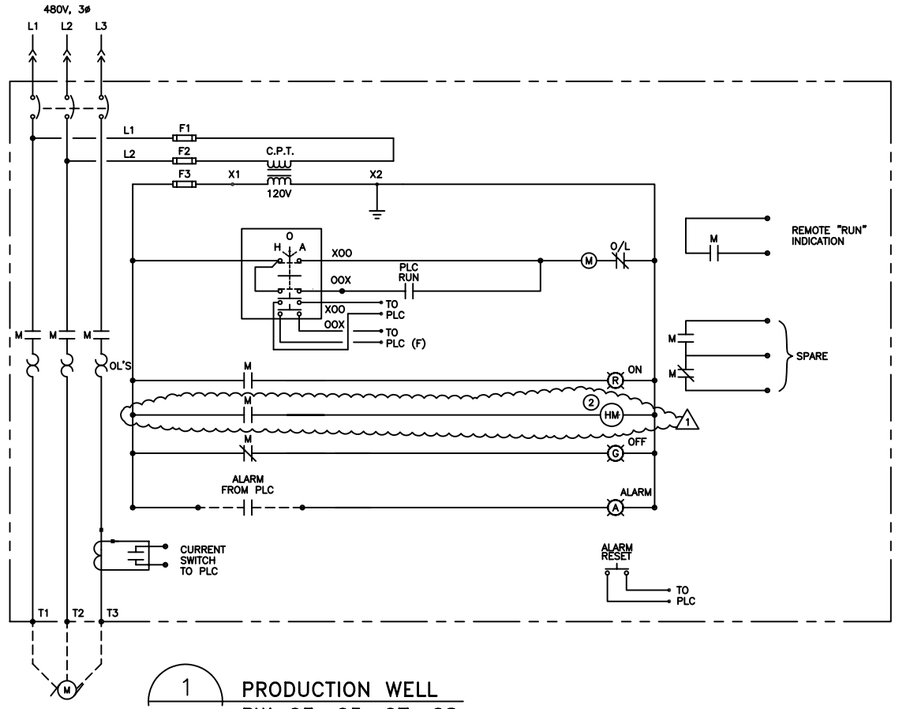
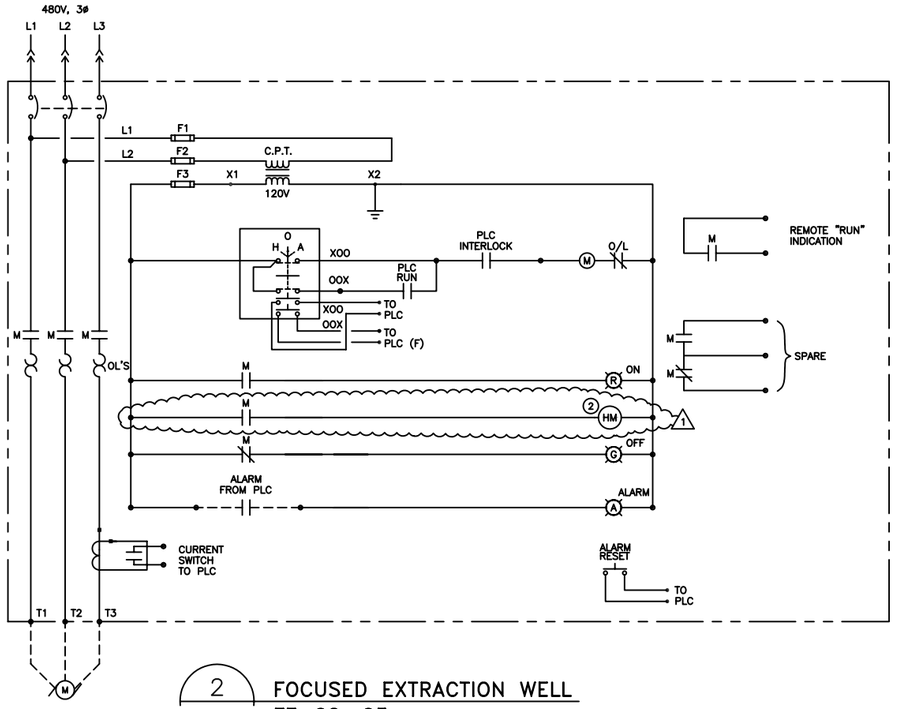
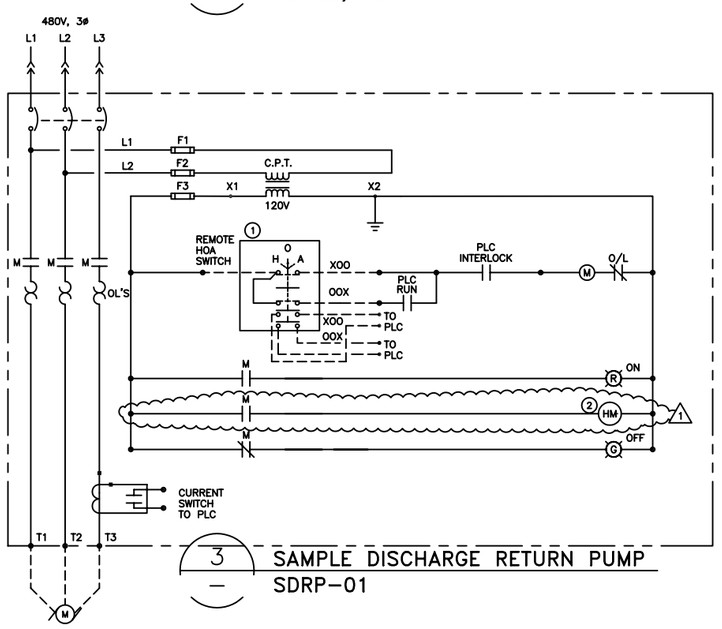



1 — PRODUCTION WELL
PW–03, 05, 07, 08




2 — FOCUSED EXTRACTION WELL
FE–02, 03




3 — SAMPLE DISCHARGE RETURN PUMP
SDRP–01

## KEYED NOTES

1 PROVIDE REMOTE SWITCH, SQUARE D TYPE SK OR EQUIVALENT, WITH LEGEND AND NEMA 1 ENCLOSURE. SWITCH OPERATOR IS SPRING RETURN FROM LEFT TO CENTER. PROVIDE SUBMITTAL FOR REVIEW.

2 PROVIDE HOUR METER, MOUNT ON MCC DOOR FRONT. REDINGTON MODEL 3311–0000.

## I/O LIST

| DESCRIPTION | SIGNAL TYPE | FROM | TO | QTY |
|---|---|---|---|---|
| HAND POSITION | DISCRETE INPUT | STARTER | PLC | 7 |
| AUTO POSITION | DISCRETE INPUT | STARTER | PLC | 7 |
| ALARM RESET | DISCRETE INPUT | STARTER | PLC | 6 |
| CURRENT SWITCH | DISCRETE INPUT | STARTER | PLC | 7 |
| ALARM | DISCRETE OUTPUT | PLC | STARTER | 6 |
| PLC RUN | DISCRETE OUTPUT | PLC | STARTER | 6 |
| PLC INTERLOCK | DISCRETE OUTPUT | PLC | STARTER | 3 |

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TETRA TECH EC, INC.

*AS-BUILT MODIFICATIONS FROM ORIGINAL DESIGN ARE DEPICTED IN RED

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| 0 | 03/09/05 | ISSUED FOR CONSTRUCTION | JH | HA |

DSGN J. HISER
DR C. ARNOLD
CHK G. LINDGREN
APVD H. AZARI

VERIFY SCALE
BAR IS ONE HALF INCH ON ORIGINAL DRAWING. 0 1/2"
IF NOT ONE HALF INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL

REYNOLDS METALS COMPANY / ALCOA, INC
FOCUSED EXTRACTION/PRODUCTION WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
ELECTRICAL
ELEMENTARY DIAGRAMS

SHEET 11
DWG E-4
DATE 03/09/05
PROJ 166034

\\ROSA\PROJ\ALCOA\166034\CAD\JAN05NEW

FILENAME: E4.dwg PLOT DATE: 17-Oct-2006 PLOT TIME: 10:03am

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## GENERAL NOTES

A REFER TO ONE-LINE DIAGRAM FOR CONDUIT AND CONDUCTOR SIZES AND DISCONNECT REQUIREMENTS.

B ROUTE CONDUITS UNDERGROUND UTILIZING PIPE TRENCH. COORDINATE WITH PIPE CONTRACTOR.

## KEYED NOTES

1 INSTALL NEW 36" x 36" HANDHOLE TO EXISTING 6"C. FIELD ROUTE NEW 4"C TO BLDG. 70 AS SHOWN.

2 ROUTE CONDUIT UP WALL TO ENTER BUILDING OVERHEAD.

3 PENDANT MOUNT TYPE "G" FLUORESCENT LUMINARIES AT 8'-6" AFF. CONNECT TO PNL-1. (1)

TYPE "G" FLUORESCENT INDUSTRIAL REFLECTOR:

| | |
|---|---|
| SIZE | 13-1/2 INCHES BY 49 INCHES BY BY 6-1/2 INCHES HIGH, NOMINAL |
| LAMP | FLUORESCENT, 2 BY 32 WATTS, T8, BI-PIN, RAPID START, 3,500 KELVIN |
| BALLAST | 120V, 60HZ, HIGH FREQUENCY ELECTRONIC |
| MOUNTING | AS INDICATED ON DRAWING |
| REFLECTOR | FORMED STEEL, 10 PERCENT UP-LIGHT COMPONENT |
| FINISH | ELECTROSTATICALLY APPLIED POWDER COAT, WHITE COLOR |
| MANUFACTURER | LITHONIA "AF" SERIES, HE WILLIAMS, COLUMBIA, OR APPROVED |

## KEYED NOTES (CONT'D)

(1) 4 POINT OF CONNECTION FOR HEATER, PROVIDE AND INSTALLATION REZNOR MODEL EGE OR EQUAL, INSTALL BOTTOM OF UNIT AT 8'-0" A.F.F.

| SIZE | KW (B.T.U.) | VOLTS | PH | C.F.M. | TEMP. RISE |
|---|---|---|---|---|---|
| 5 | 5 (17060) | 480 V | 1ϕ | 480 | 40° F |

5 ROUTE (1) ADDITIONAL 1"C UNDERGROUND FROM BLDG. 70 TO EACH PUMP UNIT FOR FUTURE USE.

6 REMOVAL OF EXISTING ENGINE BY OTHERS.

7 VERIFY LOCATION OF EXISTING CONDUIT.

8 REFERENCE SITE PLANS C2, C3, AND C5 FOR TRENCHING DETAILS.

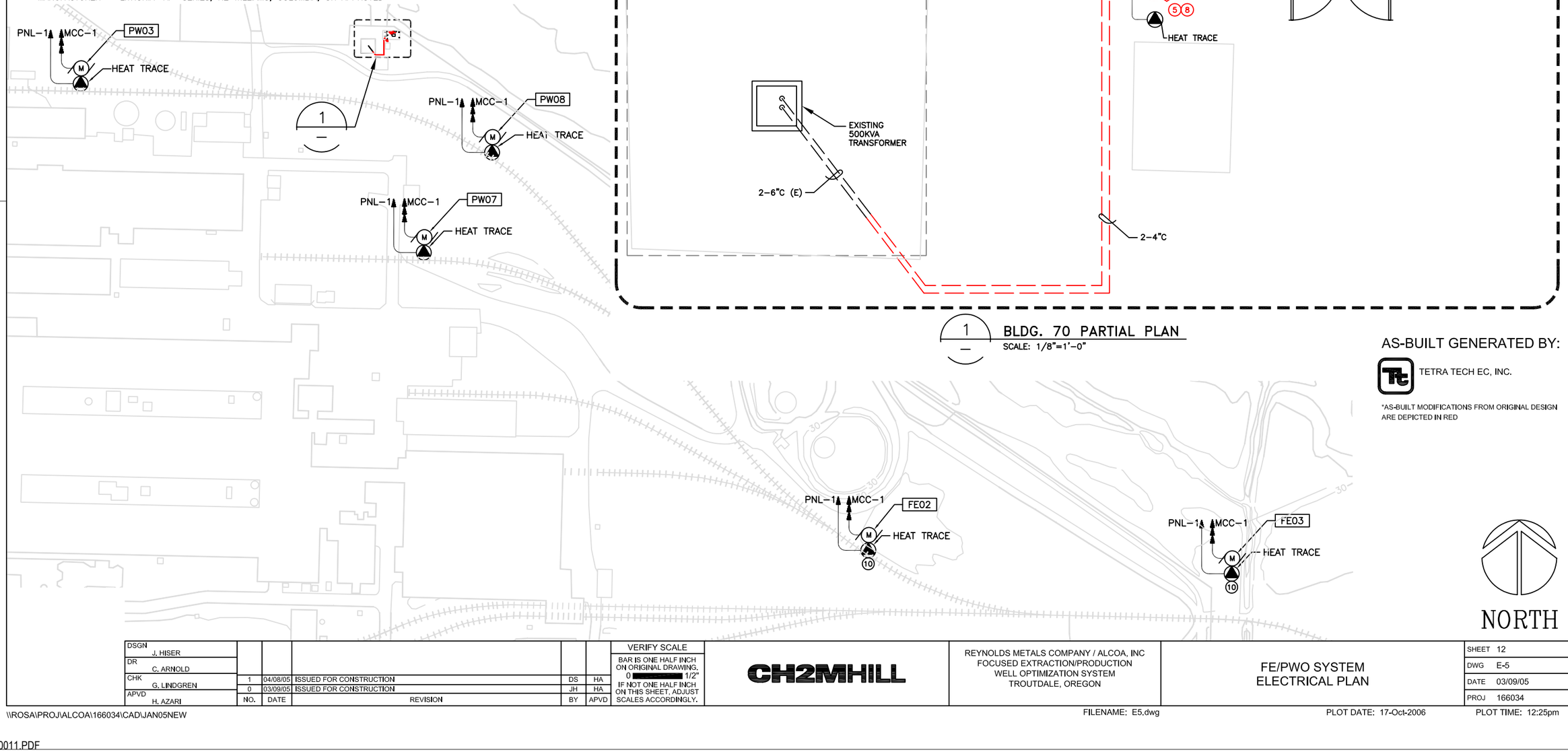
9 REMOTE HOA SWITCH. REFER TO DRAWING E-4.

10 ALLOW FOR AN EXTRA 70' OF CONDUIT AND CONDUCTOR FOR VERTICAL ROUTING DOWN PUMP SHAFT TO SUBMERSIBLE PUMP.

(1) 11 POINT OF CONNECTION FOR FLOW METER.

## KEYED NOTES (CONT'D)

12 PROVIDE J-BOX FOR FUTURE LUMINARIES. (1)




1 BLDG. 70 PARTIAL PLAN
SCALE: 1/8"=1'-0"

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DSGN J. HISER
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CH2MHILL

REYNOLDS METALS COMPANY / ALCOA, INC
FOCUSED EXTRACTION/PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
ELECTRICAL PLAN

SHEET 12
DWG E-5
DATE 03/09/05
PROJ 166034

\\ROSA\PROJ\ALCOA\166034\CAD\JAN05NEW

FILENAME: E5.dwg PLOT DATE: 17-Oct-2006 PLOT TIME: 12:25pm

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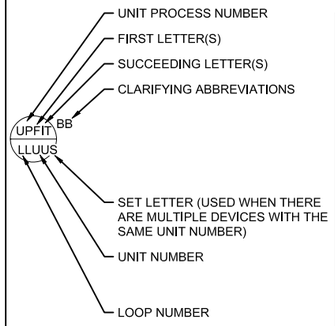
# INSTRUMENT IDENTIFICATION

## EXAMPLE SYMBOLS




## INSTRUMENT IDENTIFICATION LETTERS TABLE

| | FIRST-LETTER | | SUCCEEDING-LETTERS | | |
|---|---|---|---|---|---|
| LETTER | PROCESS OR INITIATING VARIABLE | MODIFIER | READOUT OR PASSIVE FUNCTION | OUTPUT FUNCTION | MODIFIER |
| A | ANALYSIS (+) | | ALARM | | |
| B | BURNER, COMBUSTION | | USER'S CHOICE (*) | USER'S CHOICE (*) | USER'S CHOICE (*) |
| C | USER'S CHOICE (*) | | | CONTROL | |
| D | DENSITY (S.G) | DIFFERENTIAL | | | |
| E | VOLTAGE | | PRIMARY ELEMENT, SENSOR | | |
| F | FLOW RATE | RATIO (FRACTION) | | | |
| G | USER'S CHOICE(*) | | GLASS, GAUGE VIEWING DEVICE | GATE | |
| H | HAND (MANUAL) | | | | HIGH |
| ! | CURRENT (ELECTRICAL) | | INDICATE | | |
| J | POWER | SCAN | | | |
| K | TIME, TIME SCHEDULE | TIME RATE OF CHANGE | | CONTROL STATION | |
| L | LEVEL | | LIGHT (PILOT) | | LOW |
| M | MOTION | MOMENTARY | | | MIDDLE, INTERMEDIATE |
| N | TORQUE | | USER'S CHOICE (*) | USER'S CHOICE (*) | USER'S CHOICE (*) |
| O | USER'S CHOICE (*) | | ORIFICE, RESTRICTION | | |
| P | PRESSURE, VACUUM | | POINT (TEST) CONNECTION | | |
| Q | QUANTITY | INTEGRATE, TOTALIZE | | | |
| R | RADIATION | | RECORD OR PRINT | | |
| S | SPEED, FREQUENCY | SAFETY | | SWITCH | |
| T | TEMPERATURE | | | TRANSMIT | |
| U | MULTIVARIABLE | | MULTIFUNCTION | MULTIFUNCTION | MULTIFUNCTION |
| V | VIBRATION, MECHANICAL ANALYSIS | | | VALVE, DAMPER, LOUVER | |
| W | WEIGHT, FORCE | | WELL | | |
| X | UNCLASSIFIED (+) | X AXIS | UNCLASSIFIED (+) | UNCLASSIFIED (+) | UNCLASSIFIED (+) |
| Y | EVENT, STATE OR PRESENCE | Y AXIS | | RELAY, COMPUTE, CONVERT | |
| Z | POSITION | Z AXIS | | DRIVE, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT | |

TABLE BASED ON THE INSTRUMENTATION, SYSTEMS, AND AUTOMATION SOCIETY (ISA) STANDARD.

(+) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.

(*) WHEN USED, DEFINE THE MEANING HERE FOR THE PROJECT

## DIGITAL SYSTEM INTERFACES

| | | WHERE X= |
|---|---|---|
| ▲ | ANALOG INPUT | A = ALARM |
| ▼ | ANALOG OUTPUT | H = MAINTAINED |
| $\Delta_X$ | DISCRETE INPUT | M = MOMENTARY |
| $\nabla_X$ | DISCRETE OUTPUT | S = STATUS |

## GENERAL INSTRUMENT OR FUNCTIONAL SYMBOLS

- FIELD MOUNTED
- REAR-OF-PANEL MOUNTED (OPERATOR INACCESSIBLE)
- PANEL MOUNTED (OPERATOR ACCESSIBLE)
- MCC MOUNTED
- COMPUTER FUNCTION
- PLC FUNCTION
- SHARED DISPLAY, SHARED CONTROL

## SPECIAL CASES

- YL OO — ON AND OFF EVENT LIGHTS
- HS OO — ON-OFF HAND SWITCH, MAINTAINED CONTACT SWITCH (CONTROLLED DEVICE WILL RESTART ON RETURN OF POWER AFTER POWER FAILURE).
- HS SS — STOP-START HAND SWITCH MOMENTARY CONTACT SWITCHES (CONTROLLED DEVICE WILL NOT RESTART ON RETURN OF POWER AFTER POWER FAILURE).

## TRANSDUCERS

| | | | |
|---|---|---|---|
| A | ANALOG | I | CURRENT |
| D | DIGITAL | P | PNEUMATIC |
| E | VOLTAGE | PF | PULSE FREQUENCY |
| F | FREQUENCY | PD | PULSE DURATION |
| H | HYDRAULIC | R | RESISTANCE |

EXAMPLE:

FY I/P — CURRENT TO PNEUMATIC TRANSDUCER (BACK OF PANEL, IN A FLOW LOOP)

## ACCESSORY DEVICES

EXAMPLE: TRANSMITTER AS AN ACCESSORY TO A FLOW ELEMENT

FT / T

| | | |
|---|---|---|
| A | = | ALARM |
| C | = | CONTROLLER |
| I | = | INDICATOR |
| R | = | RECORDER |
| S | = | SWITCH |
| T | = | TRANSMITTER |
| X | = | UNCLASSIFIED |

# LINE LEGEND

- PROCESS (CLOSED CONDUIT, DASHED LINE INDICATES ALTERNATE FLOW STREAM)
- PROCESS (OPEN CHANNEL)
- ANALOG SIGNAL (4 TO 20 mAdc, ETC.)
- DISCRETE SIGNAL (ON/OFF, ETC.)
- PNEUMATIC SIGNAL
- FILLED SYSTEM SIGNAL
- HYDRAULIC SYSTEM SIGNAL
- DATA LINK
- BUILDING OR FACILITY BOUNDARY
- PACKAGE SYSTEM EQUIPMENT

PARALLELING LINES

(2) 3(2)

(A) (B)

(A) TOTAL OF 2 SIGNALS

(B) 3 TYPICAL SETS OF 2 SIGNALS EACH. TOTAL OF 6 SIGNALS.

- CONNECTING LINES
- NON-CONNECTING LINES

# INTERFACE SYMBOLS

S WA — WA D

= PROCESS INTERFACE

= SIGNAL INTERFACE

W = SOURCE UNIT PROCESS NO. (1 OR 2 DIGITS)

A = INTERFACE NO. (2 DIGITS)

D = DESTINATION DRAWING NO.

S = SOURCE DRAWING NO.

N — PROCESS OR SIGNAL LINE CONTINUATION N=1,2,3,ETC — N

INTERFACE TO OR FROM PROCESS EXTERNAL TO PROJECT

# ABBREVIATIONS & LETTER SYMBOLS

| | |
|---|---|
| AC | ALTERNATING CURRENT |
| AM | AUTO-MANUAL |
| CAM | COMPUTER-AUTO-MANUAL |
| CCS | CENTRAL CONTROL SYSTEM |
| $CL_2$ etc. | CHLORINE (TYPICAL: USE STANDARD CHEMICAL ELEMENT ABBREVIATION) |
| CM | COMPUTER-MANUAL |
| COD | CHEMICAL OXYGEN DEMAND |
| CP-X | CONTROL PANEL NO. X |
| DC | DIRECT CURRENT |
| DCS | DISTRIBUTED CONTROL SYSTEM |
| DCU | DISTRIBUTED CONTROL UNIT |
| DO | DISSOLVED OXYGEN |
| $FCL_2$ | FREE CHLORINE RESIDUAL |
| FOS | FAST-OFF-SLOW |
| FOSA | FAST-OFF-SLOW-AUTO |
| FOSR | FAST-OFF-SLOW-REMOTE |
| FP-W-X | FIELD PANEL NO. WX (W = UNIT PROCESS NUMBER X = PANEL NUMBER) |
| FR | FORWARD-REVERSE |
| HOA | HAND-OFF-AUTO |
| HOR | HAND-OFF-REMOTE |
| !SR | INTRINSICALLY SAFE RELAY |
| LEL | LOWER EXPLOSIVE LIMIT |
| LOS | LOCKOUT STOP |
| LR | LOCAL-REMOTE |
| MA | MANUAL-AUTO |
| MC | MODULATE-CLOSE |
| MCC-X | MOTOR CONTROL CENTER NO. X |
| MSC | MANUFACTURER SUPPLIED CABLE |
| OC | OPEN-CLOSE (D) |
| OCR | OPEN-CLOSE-REMOTE |
| OCA | OPEN-CLOSE-AUTO |
| OO | ON-OFF |
| OOA | ON-OFF-AUTO |
| OOR | ON-OFF-REMOTE |
| ORP | OXIDATION REDUCTION POTENTIAL |
| OSC | OPEN-STOP-CLOSE |
| pH | HYDROGEN ION CONCENTRATION |
| PLC | PROGRAMMABLE LOGIC CONTROLLER |
| RIO | REMOTE I/O UNIT |
| RM-X | REMOTE MULTIPLEXING MODULE NO. X |
| RTU-X | REMOTE TELEMETRY UNIT NO. X |
| SF | SLOWER-FASTER |
| SS | START-STOP |
| SSC | SUPERVISORY SET POINT CONTROL |
| $TCL_2$ | TOTAL CHLORINE RESIDUAL |
| TOC | TOTAL ORGANIC CARBON |
| TOD | TOTAL OXYGEN DEMAND |
| TURB | TURBIDITY |
| VHC | VOLATILE HYDROCARBONS |
| VIB | VIBRATION |
| Δ | DIFFERENCE |
| Σ | SUM |
| X | MULTIPLY |
| ÷ | DIVIDE |
| f(x) | CHARACTERIZED |
| $X^n$ | RAISE TO THE Nth POWER |
| √ | SQUARE ROOT |
| AVG | AVERAGE |
| 1:1 | REPEAT OR BOOST |
| > | SELECT HIGHEST SIGNAL |
| < | SELECT LOWEST SIGNAL |
| } | BIAS |
| % | GAIN OR ATTENUATE |

# SELF CONTAINED VALVE & EQUIPMENT TAG NUMBERS

W-D-X-Y

W = UNIT PROCESS NUMBER

D:

| | |
|---|---|
| ARV | = AIR RELEASE VALVE |
| AVRV | = AIR AND VACUUM RELEASE VALVE |
| E | = EJECTOR |
| G | = GATE |
| M | = MECHANICAL EQUIPMENT |
| P | = PUMP |
| T | = TANK |

X = LOOP NUMBER

Y = UNIT NUMBER

# GENERAL NOTES

1. COMPONENTS AND PANELS SHOWN WITH A SINGLE ASTERISK (*) ARE TO BE PROVIDED AS PART OF A PACKAGE SYSTEM.
2. COMPONENTS AND PANELS SHOWN WITH A DOUBLE ASTERISK (**) ARE TO BE PROVIDED UNDER DIVISION 16, ELECTRICAL.
3. THIS IS A STANDARD LEGEND. THEREFORE, NOT ALL OF THIS INFORMATION MAY BE USED ON THIS PROJECT.

## AS-BUILT GENERATED BY:

TETRA TECH EC, INC.

*AS-BUILT MODIFICATIONS FROM ORIGINAL DESIGN ARE DEPICTED IN RED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| DSGN T. YAMADA | | | | | | | VERIFY SCALE |
| DR C. JOLE | | | | | | | BAR IS ONE HALF INCH ON ORIGINAL DRAWING. 0 1/2" IF NOT ONE HALF INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY. |
| CHK | 1 | 4/8/05 | ISSUED FOR BID | | | | |
| APVD | NO. | DATE | REVISION | BY | APVD | | |

CH2MHILL

REYNOLDS METALS / ALCOA, INC
FOCUSED EXTRACTION/PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
PROCESS AND INSTRUMENTATION
LEGEND

| | |
|---|---|
| SHEET | 13 |
| DWG | P-1 |
| DATE | MARCH 2005 |
| PROJ | 166034 |

\\ROSA\PROJ\ALCOA\166034\CAD\JAN05NEW

FILENAME: P1.dwg PLOT DATE: 17-Oct-2006 PLOT TIME: 10:04am

PDX/062960011.PDF

## VALVE SYMBOLS

- GATE
- KNIFE GATE
- BUTTERFLY
- GLOBE
- BALL
- VEE- BALL
- PLUG
- SEAT PORT ECCENTRIC PLUG
- DIAPHRAGM
- PINCH
- NEEDLE
- SWING CHECK
- BALL CHECK
- BACKFLOW PREVENTER
- ROTARY
- PRESSURE RELIEF
- AIR AND/OR VACUUM RELEASE
- REGULATED SIDE PRESSURE CONTROL
- MULTI-PORT VALVES (GATE VALVE SHOWN. FOR OTHER VALVE TYPES, APPROPRIATE VALVE SYMBOL SHOWN. ) SEAT PORTS ARE IMPLIED BY INDICATED FLOW PATTERN.
- ANGLE GATE
- TELESCOPE
- SAMPLE
- MUD
- PRESSURE REGULATING (CLAY-TYPE)

## GATE SYMBOLS

- SLUICE
- BUTTERFLY
- FABRICATED SLIDE
- FLAP
- STOP LOG

## ACTUATOR SYMBOLS

- XX PNEUMATIC DIAPHRAM SPRING-OPPOSED, SINGLE OR DOUBLE ACTING
- XX PNEUMATIC CYLINDER SINGLE OR DOUBLE ACTING ACTUATED BY ONE INPUT
- XX ELECTRIC MOTOR
- XX SOLENOID
- XX HYDRAULIC
- VALVE POSITIONER
- MANUAL
- XX ELECTROHYDRAULIC
- DIAPHRAGM, DIFFERENTIAL PRESSURE

NOTE:
ON LOSS OF PRIMARY POWER (PNEUMATIC, ELECTRICAL OR HYDRAULIC)
XX: FO =FAIL OPEN
FC =FAIL CLOSED
FLP=FAIL TO LAST POSITION

## PRIMARY ELEMENT SYMBOLS

- PARSHALL FLUME
- WEIR
- ORFICE PLATE
- FLOW TUBE
- PITOT-STATIC
- VORTEX METER
- ULTRASONIC FLOWMETER
- ELECTROMAGNETIC FLOWMETER
- PROPELLER OR TURBINE METER
- THERMAL FLOWMETER
- ROTAMETER
- DENSITY METER
- GENERIC
- LEVEL (ULTRASONIC)
- LEVEL (BUBBLER TUBE)
- LEVEL (FLOAT)

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## MISCELLANEOUS SYMBOLS

- DIAPHRAGM SEAL
- BLIND FLANGE
- AIR GAP
- VENT TO ATMOSPHERE
- AERATOR
- PLUG
- RECEPTACLE
- SELF CONTAINED AIR SUPPLY
- COMPOSITE SAMPLER (DIPPER TYPE)
- COMPOSITE SAMPLER (SUCTION TYPE)
- TV CAMERA
- INTERLOCK, SEE CONTROL DIAGRAMS
- PURGE SET X : W = WATER A = AIR SEE
- AIR SET XX= SUPPLY PRESSURE IN PSIG.
- FILTER/ REGULATOR/ GAUGE SET
- FLEXIBLE CONNECTOR
- PULSATION DAMPENER
- FILTER
- DRIP TRAP
- FLAME TRAP
- STRAINER
- HORN
- 120 VOLT, 60 HZ POWER
- 480 VOLT, 60 HZ POWER
- ANNULAR DIAPHRAGM SEAL
- RUPTURE DISK (PRESSURE)
- RUPTURE DISK (VACUUM)
- PIG INSERT POINT
- PIG CATCH POINT
- MIXER
- ELECTRIC MOTOR
- TV MONITOR
- LOGIC ELEMENT: IF A AND NOT B THEN C
- LOGIC ELEMENT: IF A OR B THEN C
- FLUSHING CONNECTION
- HOSE ADAPTOR
- SEAL WATER SET
- SIGHT GLASS
- PANEL CONTINUED ON SAME OR OTHER DRAWING
- PANEL OUTLINE
- PANEL NAME
- SKIMMING MECHANISM
- SCREW
- SCREW CONVEYOR
- INLINE SILENCER
- PIPE CAP
- CALIBRATION COLUMN

## PUMP AND COMPRESSOR SYMBOLS

NOTE: XX: AS ADJUSTABLE SPEED
CS-1 CONSTANT SPEED (SINGLE SPEED)
CS-2 CONSTANT SPEED (TWO SPEED)

- CENTRIFUGAL PUMP (DRY PIT)
- CENTRIFUGAL WET PIT PUMP OR TURBINE PUMP
- RECIPROCATING OR METERING PUMP (POSITIVE DISPLACEMENT)
- DIAPHRAGM PUMP
- GEAR PUMP OR BLOWER (POSITIVE DISPLACEMENT)
- PISTON PUMP
- PROGRESSIVE CAVITY PUMP
- COMPRESSOR (CENTRIFUGAL)
- COMPRESSOR (PISTON)
- BLOWER OR FAN (CENTRIFUGAL)
- EJECTOR
- SUBMERSIBLE SUMP PUMP
- VACUUM PUMP
- ROTARY PUMP
- SCREW PUMP

## LINE SIZE AND MATERIAL IDENTIFICATION

(FOR REFERENCE ONLY. SEE SITE AND MECHANICAL DRAWINGS)

PIPING CHANGE DATABASE SYMBOL — 18CLDI — PIPE DIAMETER IN INCHES — PIPE MATERIAL ABBREVIATION

| | |
|---|---|
| CISP | CAST IRON SOIL PIPE |
| CLDI | CEMENT LINED DUCTILE IRON |
| CLSTL | CEMENT LINED STEEL |
| CU | COPPER |
| FRP | FIBERGLASS REINFORCED PLASTIC |
| PVC | POLYVINYL CHLORIDE |
| SST | STAINLESS STEEL |
| STL | STEEL |

## FLOW STREAM IDENTIFICATION

| | |
|---|---|
| AHP | AIR,HIGH PRESSURE PROCESS |
| AI | AIR, INSTRUMENT |
| AL | ALUM |
| ALP | AIR, LOW PRESSURE PROCESS |
| ASH | SODA ASH |
| B | BRINE |
| BDS | BLENDED DIGESTED SLUDGE |
| BFE | BIO-FILTER EFFLUENT |
| BFI | BIO-FILTER INFLUENT |
| BFR | BIO-FILTER RECYCLE |
| BFW | BRINE FEEDWATER |
| BS | BRINE SLUDGE |
| BWS | BACKWASH SUPPLY |
| BYP | BYPASS |
| C | CARBON SLURRY |
| CD | CARBON DIOXIDE GAS |
| CG | CHLORINE GAS (PRESSURE) |
| CGV | CHLORINE GAS (VACUUM) |
| CHS | CHEMICAL SLUDGE |
| CL | CHLORINE LIQUID |
| CO | CONDENSATE DRAIN |
| CS | CHLORINE SOLUTION |
| CWR | COOLING WATER RETURN |
| CWS | COOLING WATER SUPPLY |
| D | DRAIN (SANITARY) |
| DAS | DIGESTED ACTIVATED SLUDGE |
| DG | DIGESTER GAS |
| DIW | DEIONIZED WATER |
| DS | DIGESTED SLUDGE |
| DW | DISTILLED WATER |
| F | FILTRATE |
| FC | FERRIC CHLORINE |
| FE | FILTER EFFLUENT |
| FI | FILTER INFLUENT |
| FOR | FUEL OIL RETURN |
| FOS | FUEL OIL SUPPLY |
| FTW | FILTER TO WASTE |
| G | NATURAL GAS |
| GAS | GASOLINE |
| GR | GRIT SLURRY |
| H | HYDROGEN GAS |
| HPR | HIGH PRESSURE RETURN (CONDENSATE) |
| HPS | HIGH PRESSURE STEAM |
| HS | HEAVY SOLIDS |
| HWR | HEATING WATER RETURN |
| HWS | HEATING WATER SUPPLY |
| LD | DRY LIME |
| LPO | LIQUID POLYMER |
| LPR | LOW PRESSURE RETURN (CONDENSATE) |
| LPS | LOW PRESSURE STEAM |
| LS | LIME SLURRY |
| LSD | LIME SLUDGE |
| ML | MIXED LIQUOR |
| MPR | MEDIUM PRESSURE RETURN (CONDENSATE) |
| MPS | MEDUIM PRESSURE STEAM |
| NA | SODIUM HYDROXIDE |
| NT | NITROGEN TRICHLORIDE |
| OF | OVERFLOW |
| P | PROPANE GAS |
| PDS | PRIMARY DIGESTED SLUDGE |
| PE | PRIMARY EFFLUENT |
| PI | PRIMARY INFLUENT |
| PLE | PLANT EFFLUENT |
| PO | POLYMER SOLUTION |
| PS | PRESSURE SEWER |
| PSD | PRIMARY SLUDGE |
| PSM | PRIMARY SCUM |
| RAS | RETURN ACTIVATED SLUDGE |
| RB | RAW BRINE |
| RCS | RECARBONATION SLUDGE |
| RCY | RECYCLE |
| RHW | RECIRCULATED HOT WATER |
| RS | RAW SEWAGE |
| RSD | RECIRCULATED SLUDGE |
| S | SANITARY SEWER (GRAVITY) |
| SA | SAMPLE |
| SAS | SODA ASH SOLUTION |
| SB | SPENT BRINE |
| SC | COLD SLUDGE |
| SDG | SULFUR DIOXIDE GAS |
| SDL | SULFUR DIOXIDE LIQUID |
| SDS | SULFUR DIOXIDE SOLUTION |
| SDV | SULFUR DIOXIDE GAS (VACUUM) |
| SE | SECONDARY EFFLUENT |
| SH | HEATED SLUDGE |
| SSD | SECONDARY DIGESTED SLUDGE |
| SSM | SECONDARY SCUM |
| SW | SURFACE WASH |
| TAS | THICKENED ACTIVATED SLUDGE |
| TB | TREATED BRINE |
| TBS | THICKENER BOTTOM SLUDGE |
| TDS | THICKENED DIGESTED SLUDGE |
| TPS | THICKENED PRIMARY SLUDGE |
| TUF | THICKENER UNDERFLOW |
| UD | UNDERDRAIN |
| V | VENT |
| VAC | VACUUM |
| WAS | WASTE ACTIVATED SLUDGE |
| W1 | NO. 1 (POTABLE) WATER |
| W2 | NO. 2 (NONPOTABLE) WATER |
| W3 | NO. 3 WATER |
| W4 | NO. 4 WATER |

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DR C. JOLE
CHK
APVD

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REYNOLDS METALS / ALCOA, INC
FOCUSED EXTRACTION/PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

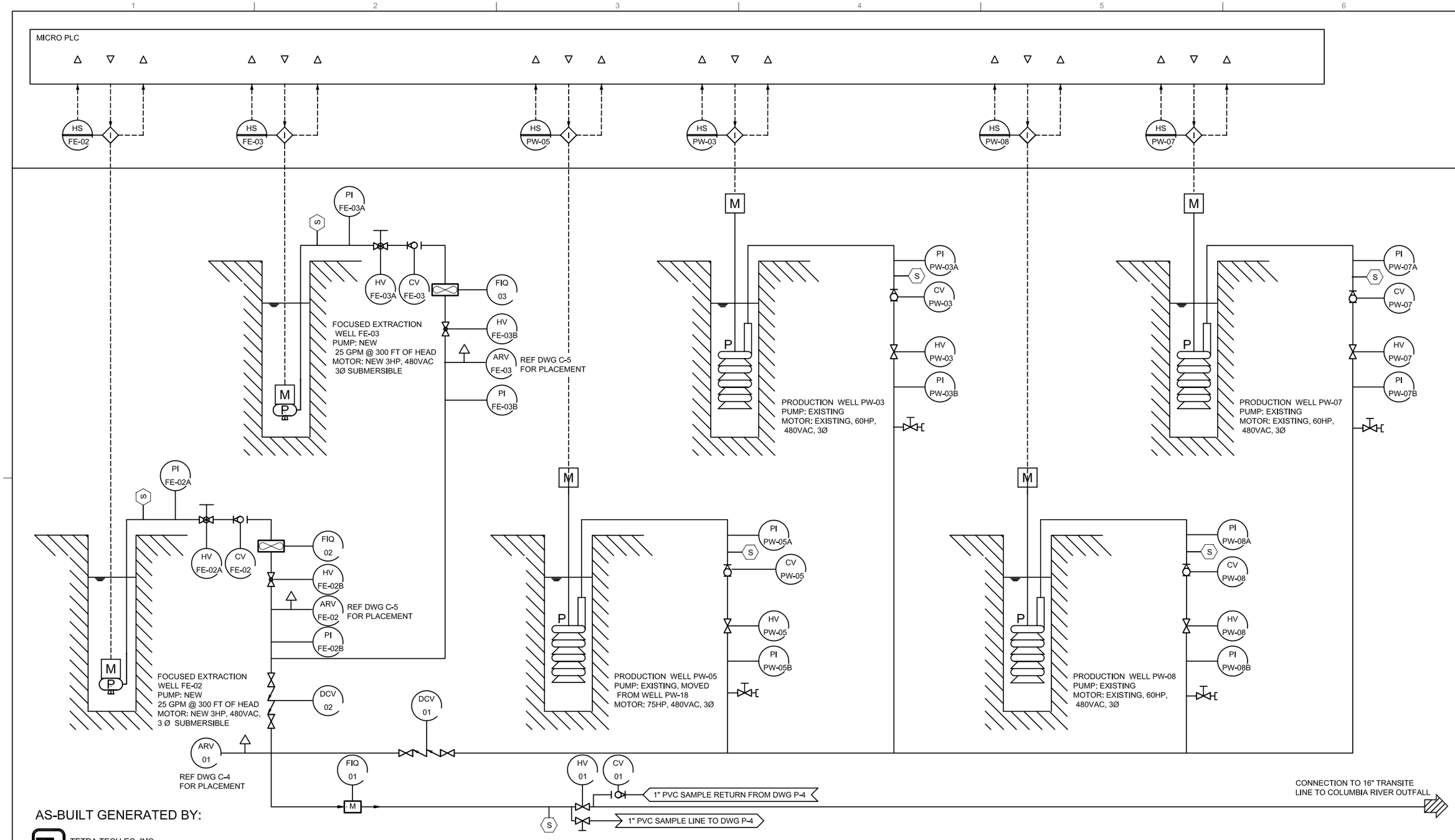
# FE/PWO SYSTEM PROCESS AND INSTRUMENTATION SYMBOL LEGEND

SHEET 14
DWG P-2
DATE MARCH 2005
PROJ 166034

\\ROSA\PROJ\ALCOA\166034\CAD\JAN05NEW

FILENAME: P2.dwg PLOT DATE: 17-Oct-2006 PLOT TIME: 10:05am

PDX/062960011.PDF

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FOCUSED EXTRACTION/PRODUCTION WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
PROCESS & INSTRUMENTATION DIAGRAM
FE WELLS AND PRODUCTION WELLS

| | |
|---|---|
| SHEET | 15 |
| DWG | P-3 |
| DATE | MARCH 2005 |
| PROJ | 166034 |

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FILENAME: P3.dwg PLOT DATE: 17-Oct-2006 PLOT TIME: 10:07am

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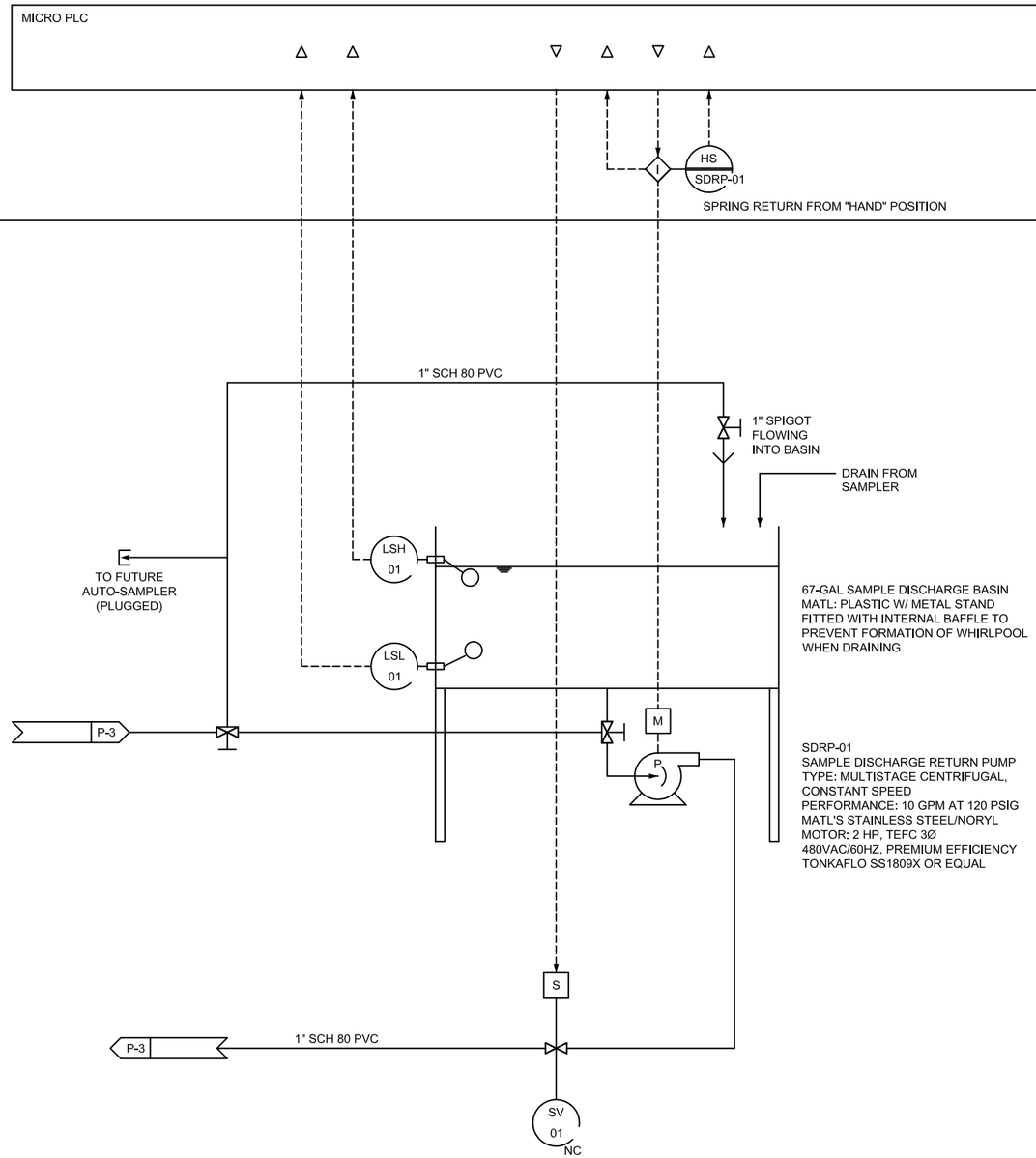


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DR C. JOLE
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FOCUSED EXTRACTION/PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
PROCESS & INSTRUMENTATION DIAGRAM
SAMPLE DISCHARGE BASIN

SHEET 16
DWG P-4
DATE MARCH 2005
PROJ 166034

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FILENAME: P4.dwg PLOT DATE: 17-Oct-2006 PLOT TIME: 10:08am

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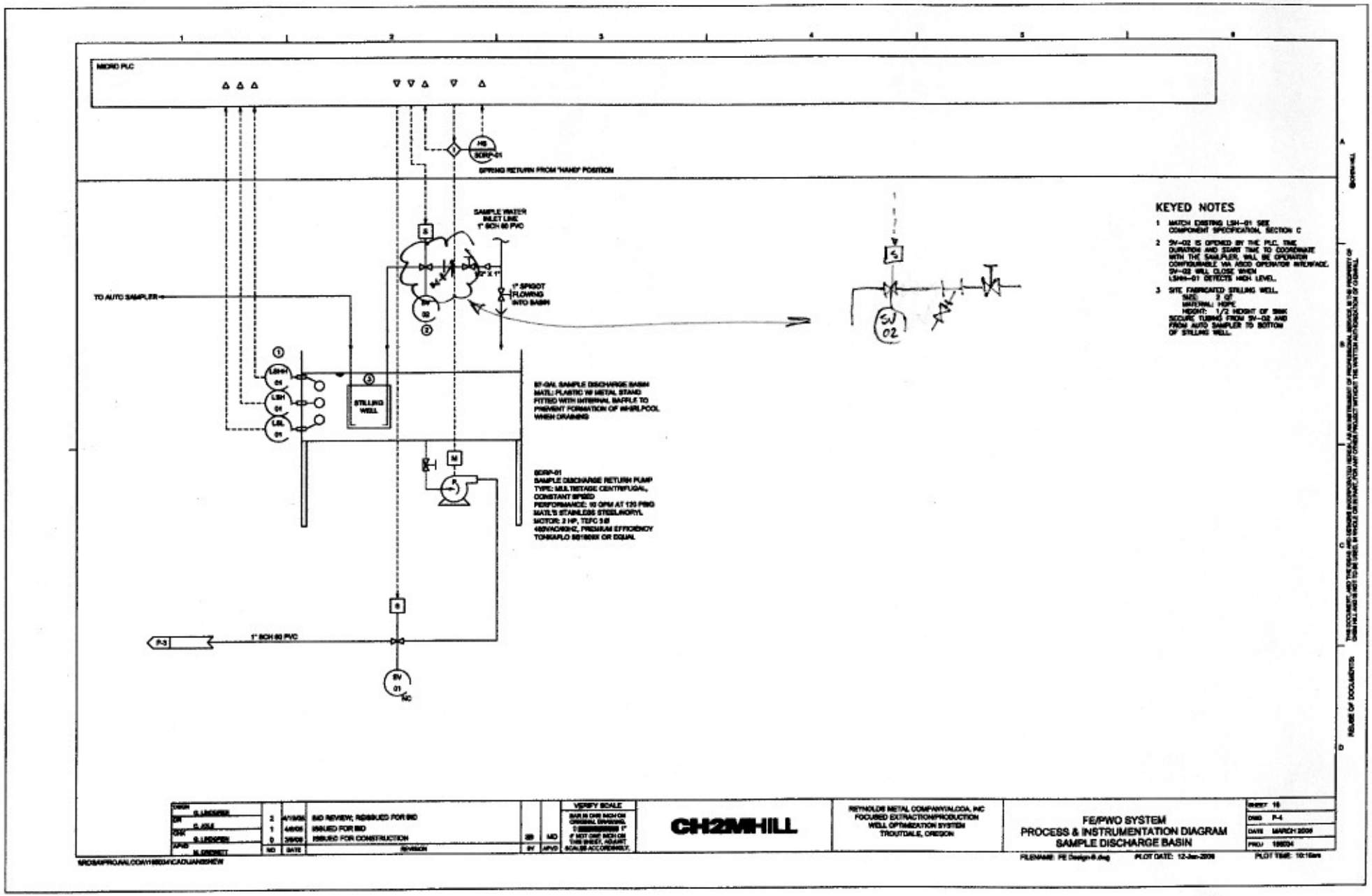
MICRO PLC
HS
SCRP-01
SPRING RETURN FROM "HAND" POSITION
SAMPLE WATER INLET LINE 1" SCH 80 PVC
1" SPIGOT FLOWING INTO BASIN
TO AUTO SAMPLER
LSHH 01
LSH 01
LSL 01
STILLING WELL
87-GAL SAMPLE DISCHARGE BASIN
MATL: PLASTIC W/ METAL STAND
FITTED WITH INTERNAL BAFFLE TO PREVENT FORMATION OF WHIRLPOOL WHEN DRAINING
SCRP-01
SAMPLE DISCHARGE RETURN PUMP
TYPE: MULTISTAGE CENTRIFUGAL, CONSTANT SPEED
PERFORMANCE: 10 GPM AT 120 FWG
MATL'S STAINLESS STEEL/NORYL
MOTOR: 2 HP, TEFC 3Ø
480VAC/60Hz, PREMIUM EFFICIENCY
TORO/APLO 5016000 OR EQUAL
P-3
1" SCH 80 PVC
SV 01
NC
SV 02
KEYED NOTES
1 MATCH EXISTING LSH-01 SEE COMPONENT SPECIFICATION, SECTION C
2 SV-02 IS OPENED BY THE PLC. TIME DURATION AND START TIME TO COORDINATE WITH THE SAMPLER, WILL BE OPERATOR CONFIGURABLE VIA ASCO OPERATOR INTERFACE. SV-02 WILL CLOSE WHEN LSHH-01 DETECTS HIGH LEVEL.
3 SITE FABRICATED STILLING WELL.
SIZE: 3" Ø
MATERIAL: HDPE
HEIGHT: 1/2 HEIGHT OF TANK
SECURE TUBING FROM SV-02 AND FROM AUTO SAMPLER TO BOTTOM OF STILLING WELL.
REVISION
2 4/19/06 BID REVIEW; REISSUED FOR BID
1 4/6/06 ISSUED FOR BID
0 3/6/06 ISSUED FOR CONSTRUCTION
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TROUTDALE, OREGON
FE/PWO SYSTEM
PROCESS & INSTRUMENTATION DIAGRAM
SAMPLE DISCHARGE BASIN
SHEET 16
DWG P-4
DATE MARCH 2006
PROJ 156034
FILENAME: FE Design-8.dwg
PLOT DATE: 12-Jan-2006
PLOT TIME: 10:15am

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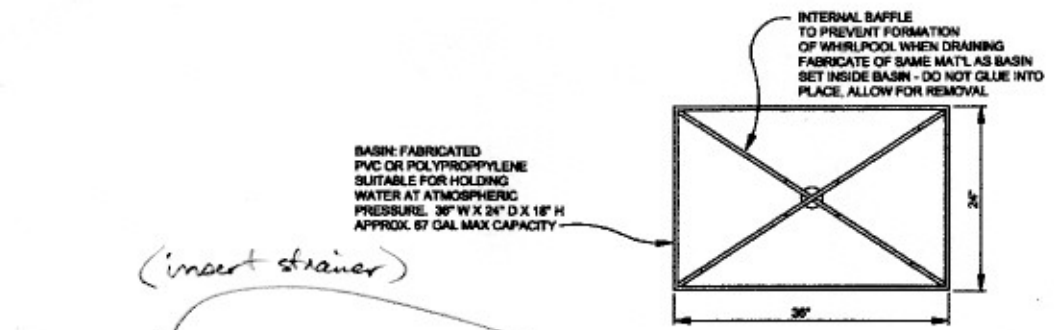


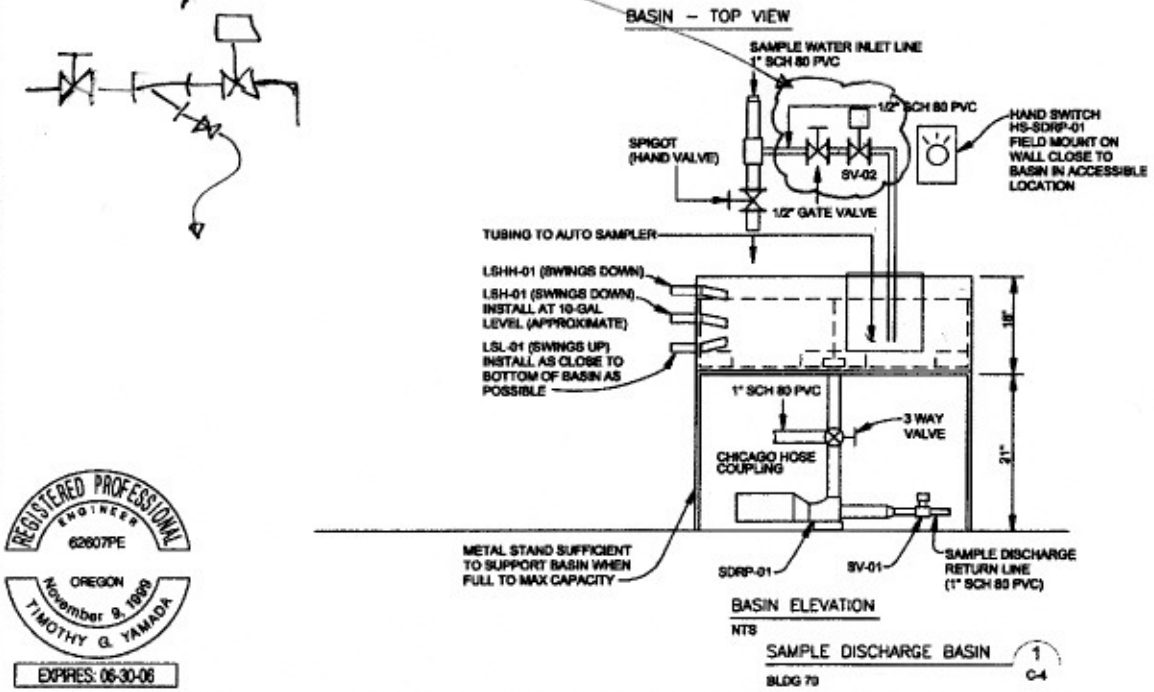


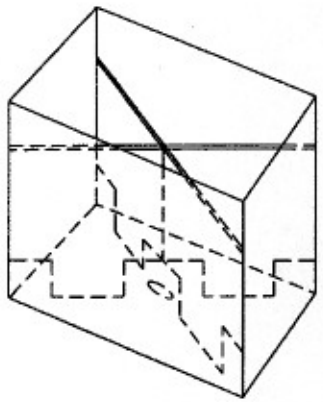


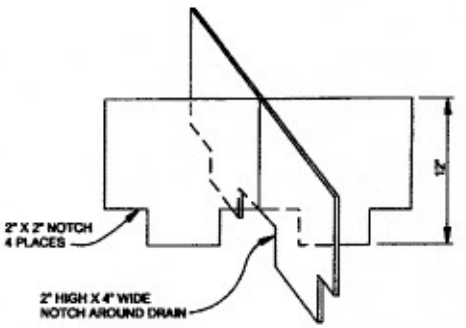


SAMPLE DISCHARGE BASIN (1)
BLDG 70 C-4

REGISTERED PROFESSIONAL ENGINEER
62607PE
OREGON
November 9, 1999
TIMOTHY G. YAMADA
EXPIRES: 06-30-06

| NO. | DATE | REVISION | BY | APVD |
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| 2 | 4/18/05 | BID REVIEW COMMENTS; REISSUED FOR BID | TY | |
| 1 | 4/4/05 | ISSUED FOR BID | TY | |
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DES: S. BRADY
CHK: T. YAMADA
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WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
SAMPLE DISCHARGE BASIN
DETAILS

SHEET 7
DWG C-7
DATE MARCH 2005
PROJ 166094

\\ROSAVPROJ\ALOCW\166094\CAD\JAGSHEW
FILENAME: 166094_SP_MW007.dwg PLOT DATE: 13-Jan-2006
PLOT TIME: 10:18am

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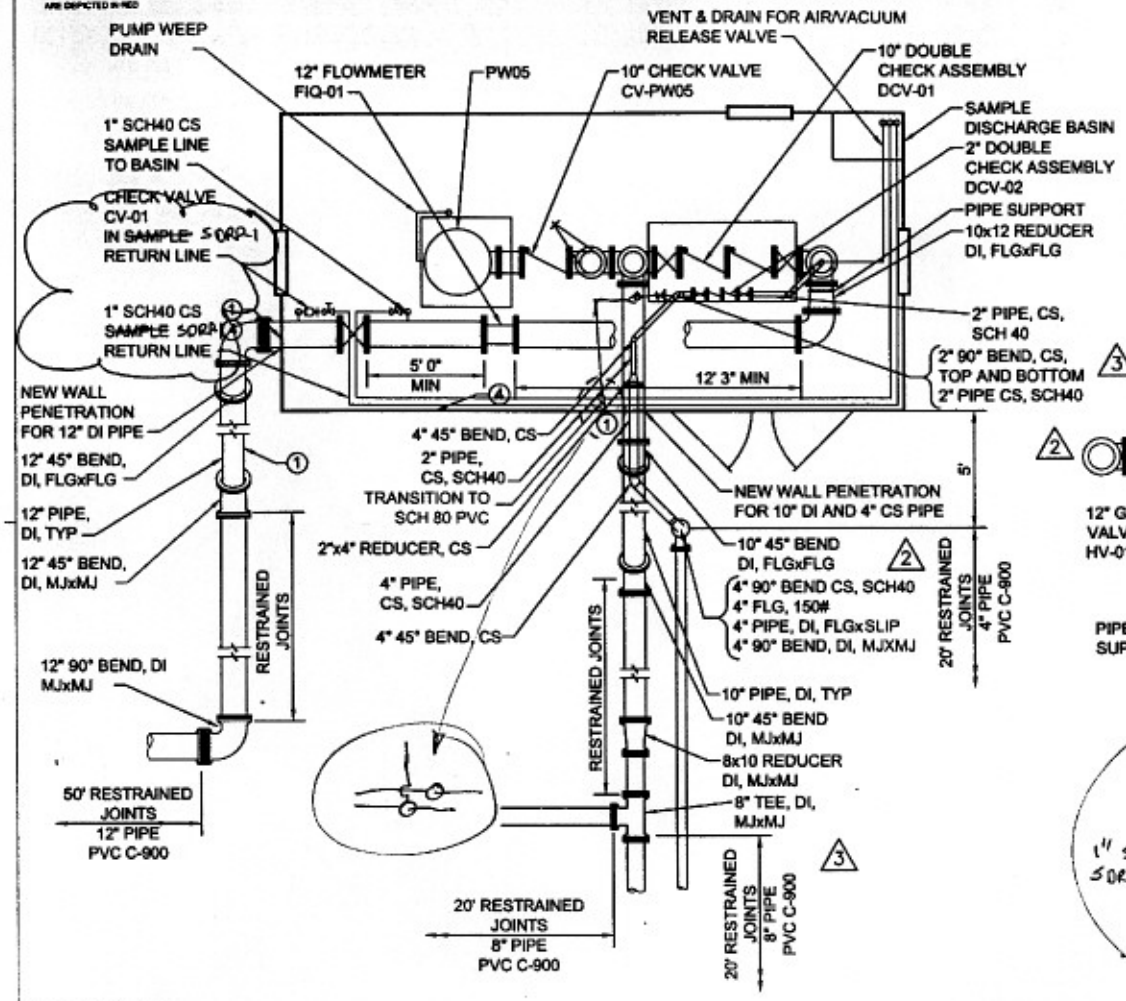
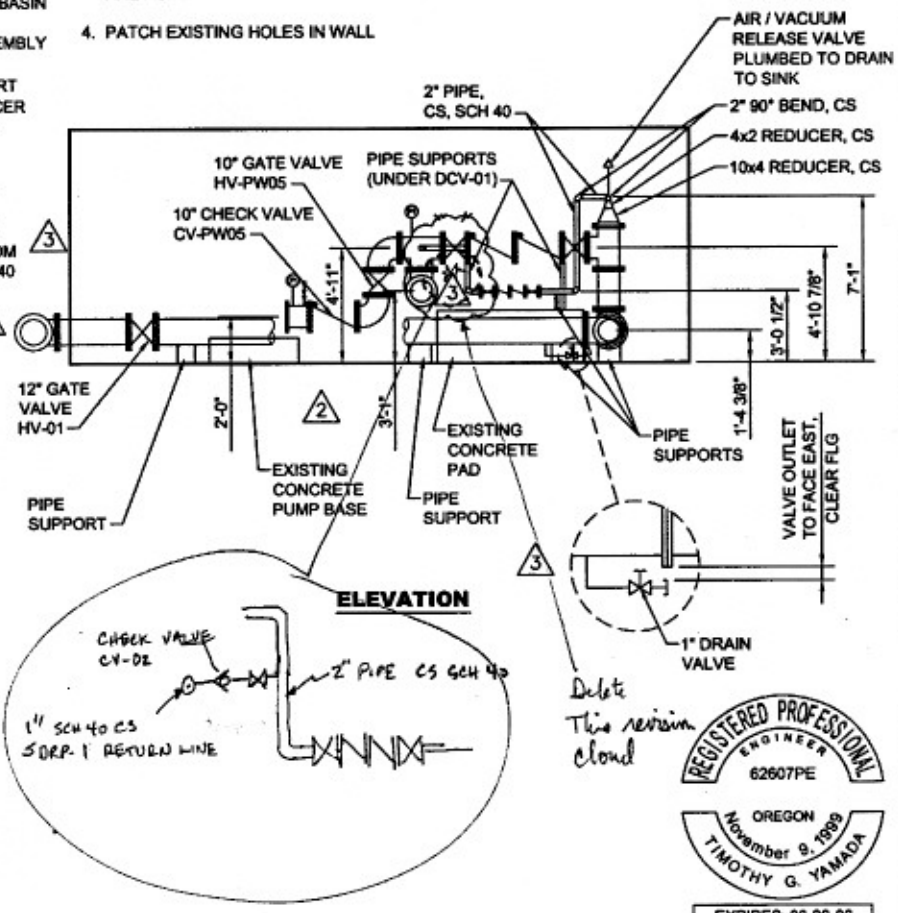
1. ALL EXTERIOR ABOVE GROUND PIPE SHALL BE HEAT TRACED AND INSULATED. INSULATION AND JACKET SHALL EXTEND BELOW GROUND TO FIRST BURIED BEND.
2. CONTRACTOR TO REMOVE PAINT FLAKES ON ALL WALLS, CEILING, AND FLOOR. ASSUME PAINT CONTAINS LEAD.
3. CONTRACTOR TO REMOVE ALL EXISTING ABOVE GROUND INTERIOR AND EXTERIOR PIPE. ASSUME ALL EXISTING GASKETS ARE ACM.
4. PATCH EXISTING HOLES IN WALL


PUMP WEEP DRAIN
VENT & DRAIN FOR AIR/VACUUM RELEASE VALVE
12" FLOWMETER FIQ-01
PW05
10" CHECK VALVE CV-PW05
10" DOUBLE CHECK ASSEMBLY DCV-01
SAMPLE DISCHARGE BASIN
2" DOUBLE CHECK ASSEMBLY DCV-02
PIPE SUPPORT
10x12 REDUCER DI, FLGxFLG
1" SCH40 CS SAMPLE LINE TO BASIN
CHECK VALVE CV-01 IN SAMPLE SDRP-1 RETURN LINE
1" SCH40 CS SAMPLE SDRP-1 RETURN LINE
2" PIPE, CS, SCH 40
2" 90° BEND, CS, TOP AND BOTTOM 2" PIPE CS, SCH40
5' 0" MIN
12' 3" MIN
NEW WALL PENETRATION FOR 12" DI PIPE
12" 45° BEND, DI, FLGxFLG
12" PIPE, DI, TYP
12" 45° BEND, DI, MJxMJ
4" 45° BEND, CS
2" PIPE, CS, SCH40
TRANSITION TO SCH 80 PVC
2"x4" REDUCER, CS
4" PIPE, CS, SCH40
4" 45° BEND, CS
NEW WALL PENETRATION FOR 10" DI AND 4" CS PIPE
10" 45° BEND DI, FLGxFLG
4" 90° BEND CS, SCH40
4" FLG, 150#
4" PIPE, DI, FLGxSLIP
4" 90° BEND, DI, MJXMJ
5'
20' RESTRAINED JOINTS 4" PIPE PVC C-900
RESTRAINED JOINTS
10" PIPE, DI, TYP
10" 45° BEND DI, MJxMJ
8x10 REDUCER DI, MJxMJ
8" TEE, DI, MJxMJ
12" 90° BEND, DI MJxMJ
50' RESTRAINED JOINTS 12" PIPE PVC C-900
20' RESTRAINED JOINTS 8" PIPE PVC C-900
20' RESTRAINED JOINTS 8" PIPE PVC C-900







Delete This revision cloud

REGISTERED PROFESSIONAL ENGINEER
62607PE
OREGON
November 9, 1999
TIMOTHY G. YAMADA
EXPIRES: 06-30-06

## BLDG 70 PIPING PLAN

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|---|---|---|---|---|
| 3 | 4/22/05 | PIPE REVISIONS; REISSUED FOR BID | SB | TY |
| 2 | 4/13/05 | PIPE REVISIONS; REISSUED FOR BID | SB | TY |
| 1 | 4/6/05 | ISSUED FOR BID | SB | TY |
| 0 | 3/9/05 | ISSUED FOR CONSTRUCTION | SB | TY |

DSGN T. YAMADA; DR C. JOLE; CHK S. LINDGREN; APVD

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REYNOLDS METALS / ALCOA, INC
FOCUSED EXTRACTION/PRODUCTION
WELL OPTIMIZATION SYSTEM
TROUTDALE, OREGON

FE/PWO SYSTEM
PIPING ALIGNMENT AND SITE LAYOUT
DETAIL SHEET - PIPING - ACCESS VAULTS

SHEET 4; DWG C-4; DATE MARCH 2005; PROJ 166034

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FILENAME: 166034_SP_MW003.dwg PLOT DATE: 03-Mar-2005 PLOT TIME: 1:32pm

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# APPENDIX B
# FE/PWO Performance Monitoring

# Focused Extraction/Production Well Optimization System Startup Performance Monitoring Results and Conclusions

PREPARED FOR: Chip Humphrey/EPA
Curt Black/EPA

PREPARED BY: Scott Dethloff/CH2M HILL
Ken Trotman/CH2M HILL
Kira Sykes/CH2M HILL

COPIES: Mavis Kent/DEQ
Steve Shaw/Reynolds Metals Company
Mark Stiffler/Alcoa

DATE: June 27, 2006

PROJECT NUMBER: 166034.07.09.10

This memorandum provides documentation that the Focused Extraction/Production Well Optimization (FE/PWO) system installed at the Reynolds Metals Company Troutdale Superfund site is complete and operational. This memorandum further provides documentation that demonstrates that the FE/PWO system is functioning as designed and is capable of meeting the established performance criteria. This documentation is provided consistent with the requirements identified in the following:

- *Unilateral Administrative Order (UAO) for Remedial Design and Remedial Action, Docket No. CERCLA 10-2005-0217* (U.S. Environmental Protection Agency [EPA], August 5, 2005)
- *Memorandum WP No. 65: Work Plan for Focused Extraction System Design and Installation* (CH2M HILL, December 2004)
- *Memorandum WP No. 69: Focused Extraction and Production Well Optimization System Startup Performance Monitoring Plan* (CH2M HILL, November 2005)

Technical information is provided in this memorandum as a PowerPoint presentation (Attachment). This presentation was provided to representatives of EPA and the Oregon Department of Environmental Quality (DEQ) on May 25, 2006.

## Background Information

Construction of the FE/PWO system began in July and was completed in October 2005. Installation of this groundwater remediation system was completed as required in accordance with the UAO.


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Major construction elements for the FE/PWO system included the following:

- Modification of the aboveground wellheads at production wells PW03, 05, 07, and 08 to include new ductile iron pipe, check and gate valves, pressure indicators, and heat tracing
- Installation of pumps and controls at focused extraction wells FE02 and FE03, including isolation and check valves, flowmeters, pressure indicators, and heat tracing
- Removal of the pump and motor from PW18 and reinstallation of this equipment at PW05
- Upgrades to Building 70 and installation of the motor control center, electrical panels, and a programmable logic computer for system operation
- Installation of conveyance piping from the FE and production wells to the existing National Pollutant Discharge Elimination System (NPDES) discharge line

Startup performance monitoring of the system began on November 4, 2005. Startup monitoring included implementation of step tests at FE02 and 03, one week of baseline monitoring, and then constant-rate tests at FE02 and FE03. Startup monitoring was completed in mid-November and continuous operation of the FE/PWO system began on November 21, 2005. Performance monitoring of the system was completed in May 2006 in accordance with the following work plans:

- *Memorandum WP No. 68: Sitewide Groundwater Monitoring Plan (2006 Through 2010) at RMC-Troutdale* (CH2M HILL, October 2005)
- *Memorandum WP No. 69: Focused Extraction and Production Well Optimization System Startup Performance Monitoring Plan* (CH2M HILL, November 2005)

## Report Organization

The attached PowerPoint presentation has been modified slightly from the original presented on May 25, 2006. Because the meeting included discussion of topics other than groundwater, slides not related to the FE/PWO system have been deleted. In addition, three slides (numbers 13, 15, and 32) addressing agency comments provided after the meeting have been included. Slide 41 (previously slide 43) was revised to match the system start time as used in the other slides.

Information included in the attached PowerPoint presentation is organized as follows:

- Slides 1 to 5: Introductions, performance monitoring objectives, schedule, and testing summary
- Slides 6 to 12: System flow rates and baseline (2005) groundwater contour maps
- Slides 13 to 19: Precipitation and Columbia River stage data, startup hydrographs, drawdown observations, and FE well recovery data
- Slides 20 to 26: Groundwater elevation contour maps in South Plant area, pre-pumping through conclusion of the startup period (November 2005 to May 2006)


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- Slides 27 to 30: Drawdown and recovery observations and straight line distance drawdown plots for FE02 and FE03
- Slides 31 to 32: Fluoride concentration reduction predictions in upper gray sand (UGS) and intermediate groundwater zones, from *Focused Feasibility Study* (CH2M HILL, June 2000), Figures A-34 and A-33
- Slides 33 to 36: Data analysis information
- Slides 37 to 47: Water quality and mass removed data summaries
- Slides 48 to 50: Summary information

# Conclusions

Data collected over the November 2005 to May 2006 startup period, and summarized in the attached PowerPoint presentation, demonstrate that the system performance is consistent with expectations as defined in the *Focused Feasibility Study*:

- Groundwater contour maps demonstrate good capture of the fluoride plume.
- Distance drawdown plots show that pumping influences extend to the edges of the known fluoride plume.
- The observed system performance matches microfem modeling results prepared for the Focused Feasibility Study.
- Fluoride concentration trends indicate capture and that mass is being removed by the system.

On the basis of the above information, it is the conclusion of RMC and CH2M HILL that the startup and operation requirements identified in the *Unilateral Administrative Order for Remedial Design and Remedial Action* (EPA, August 5, 2005) have been satisfied and the system is capable of meeting the established performance criteria.


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**ATTACHMENT**

# PowerPoint Presentation

# May Monthly Agency Meeting

## Risk and Groundwater Focus

Reynolds Metals Company/Alcoa Troutdale Facility

May 25, 2006

# FE/PWO PERFORMANCE MONITORING

- Review of Objectives and Reporting
- Performance Evaluation Results
- Conclusions

# FE/PWO PMP Objectives

- **Establish operation pumping rates at FE02-046 and FE03-045**
- **Determine the area of influence of the focused extraction system**
- **Determine fluoride and cyanide concentration trends during the focused extraction system startup**
- **Determine whether additional focused extraction wells are required to establish hydraulic control over the area where fluoride concentrations exceed the limits established in the Record of Decision (ROD)**
- **Determine whether additional piezometers are required to assess system performance**

# FE/PWO PERFORMANCE MONITORING

**Table 1**
**Focused Extraction Performance Monitoring Program**

| | | 2-Hour Step Test | | | Baseline Water Level Monitoring[a] | | | FE02 Constant-Rate Pumping Test | | | FE02 and FE03 Constant-Rate Pumping Test[b] | | | Monthly Monitoring for 5 Months[c] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well Location** | **Well ID** | **Water Levels** | **Fluoride** | **Cyanide** | **Water Levels** | **Fluoride** | **Cyanide** | **Water Levels** | **Fluoride** | **Cyanide** | **Water Levels** | **Fluoride** | **Cyanide** | **Water Levels** | **Fluoride** | **Cyanide** |
| **Columbia River** | Columbia River-Gresham sand and gravel obs point | | | | 30-min. Intervals for 1 week (Transducer) | | | 30-min Intervals During Test (Transducer) | | | 30-min Intervals During Test (Transducer) | | | Monthly | | |
| **Primary Observation Well Network** | FE02-046 | Logarithmically During Test (Transducer) | 1 (end) | | 30-min. Intervals for 1 week (Transducer) | | | Logarithmically During Test (Transducer) | 3 | 1 (end) | Logarithmically During Test (Transducer) | 1 | | Monthly | Monthly | Monthly |
| | FE03-045 | Logarithmically During Test (Transducer) | 1 (end) | | 1 (Beginning) | | | Logarithmically During Test (Transducer) | | | Logarithmically During Test (Transducer) | 3 | 1 (end) | Monthly | Monthly | Monthly |
| | MW33-033 | | | | 15 min. Intervals for 1 week (Transducer) | | | 15 min. Intervals During Test (Transducer) | | | 15 min. Intervals During Test (Transducer) | | | | | |
| | MW34-038 | 1 (Beginning) | | | 1 (Beginning) | 1 | | Logarithmically During Test (Transducer) | | | Logarithmically During Test (Transducer) | | | Monthly | 1 (Jan) | |
| | MW55-046 | 1 (Beginning) | | | 1 (Beginning) | 1 | | Logarithmically During Test (Transducer) | | | Logarithmically During Test (Transducer) | | | Monthly | 1 (Jan) | |
| | MW56-046 | 1 (Beginning) | | | 1 (Beginning) | 1 | | Logarithmically During Test (Transducer) | | | Logarithmically During Test (Transducer) | | | Monthly | 1 (Jan) | |
| **Secondary Observation Well Network** | FE01-046 | 1 (Beginning) | | | 1 (Beginning) | | | Hourly (manually) | | | Hourly (manually) | | | Monthly | | |
| | MW35-038 | 1 (Beginning) | | | 1 (Beginning) | | | Hourly (manually) | | | Hourly (manually) | | | Monthly | | |
| | MW49-095 | 1 (Beginning) | | | 1 (Beginning) | | | 2[d] | | | 2[d] | | | Monthly | | |
| | MW02-034 | 1 (Beginning) | | | 1 (Beginning) | | | 2[d] | | | 2[d] | | | Monthly | | |
| | MW10-023 | | | | | | | | | | | | | Added | | |
| | MW10-090 | | | | | | | | | | | | | Added | | |
| | MW42-027 | | | | | | | | | | | | | Added | | |

Notes:

[a] Assumes the facilities production wells have been pumping at a constant rate for a minimum of 1 month prior to the start of the observation period. If the production wells have not been pumping at a constant rate for 1 month prior to the observation period, a two-week baseline observation period may be required.

[b] The duration of FE02 and FE03 combined pumping test may be shortened based on results of the 72-hour FE02 pumping test.

[c] The monthly monitoring is assumed to start in December and continue through April until the first quarterly sampling in May 2006.

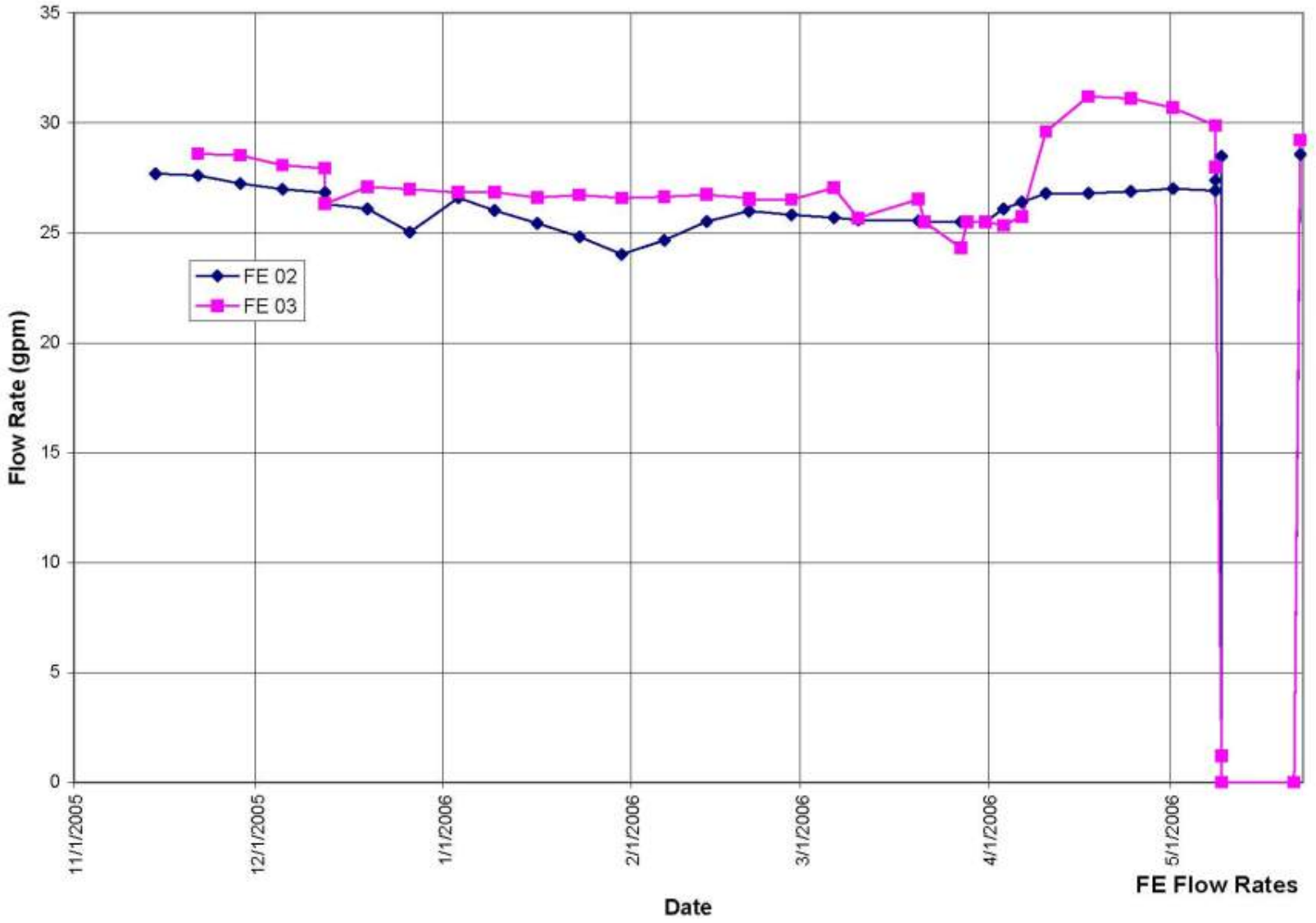
[d] Water level will be measured at the beginning and end of the pump test.

# AQUIFER TEST

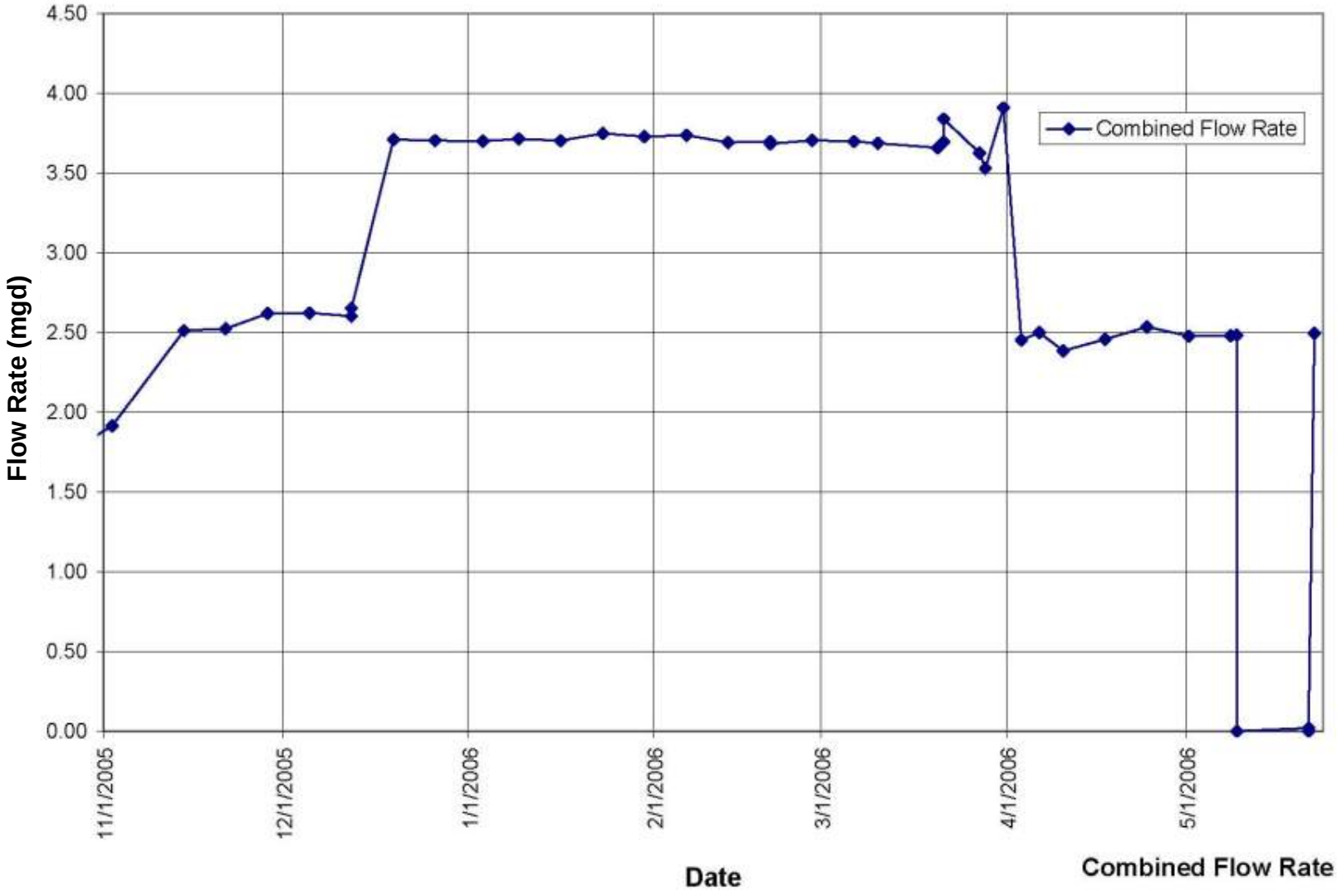
- *Step Test*
- *Baseline Water Level Monitoring*
- *FE02 Constant-Rate Pumping Test*
- *FE02 Recovery Phase*
- *FE02/FE03 Constant-Rate Pumping Test*

# FE02 and FE03 Flow Rates

*Establish operation pumping rates at FE02-046 and FE03-045*

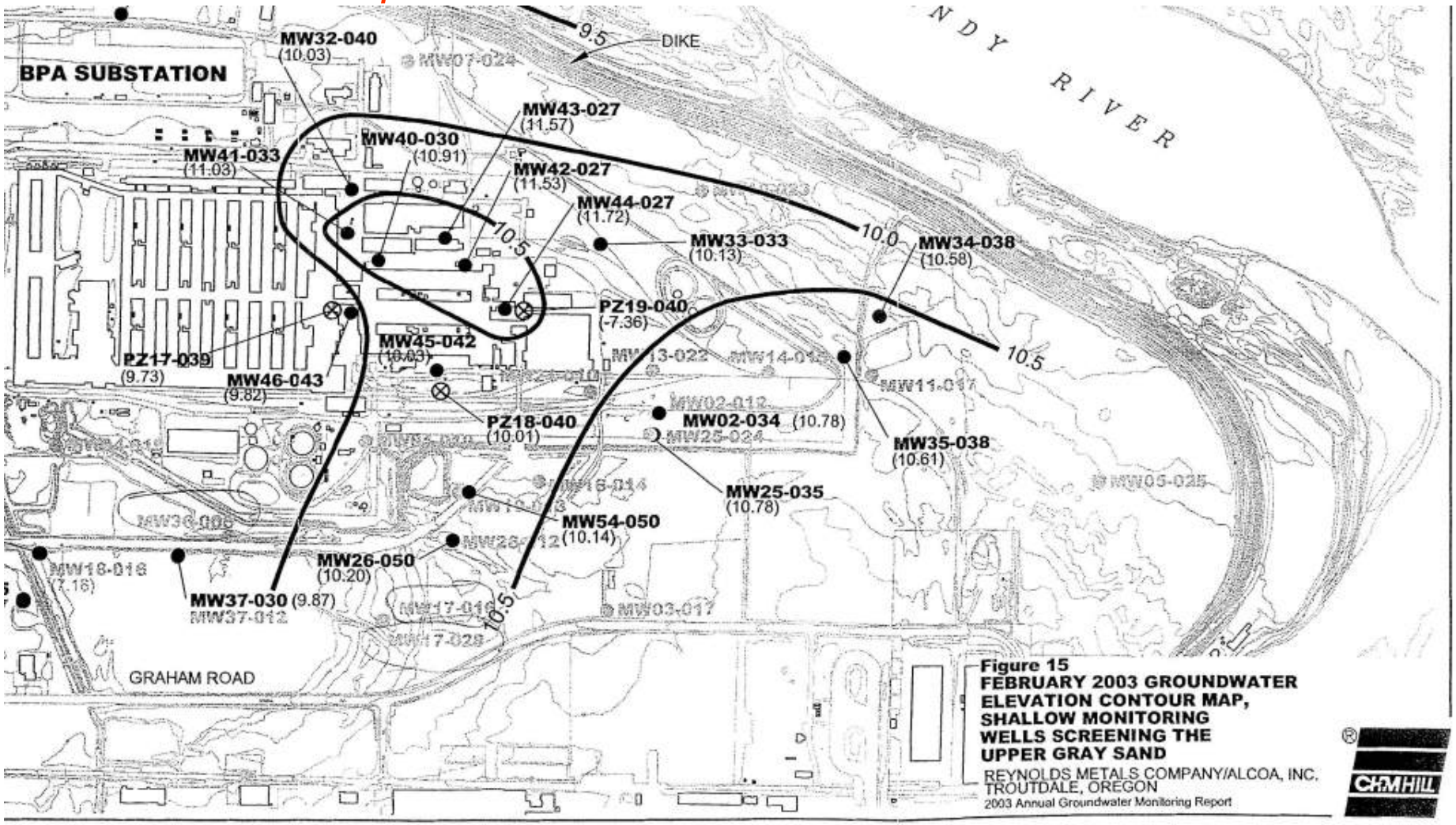


# Combined Flow Rate



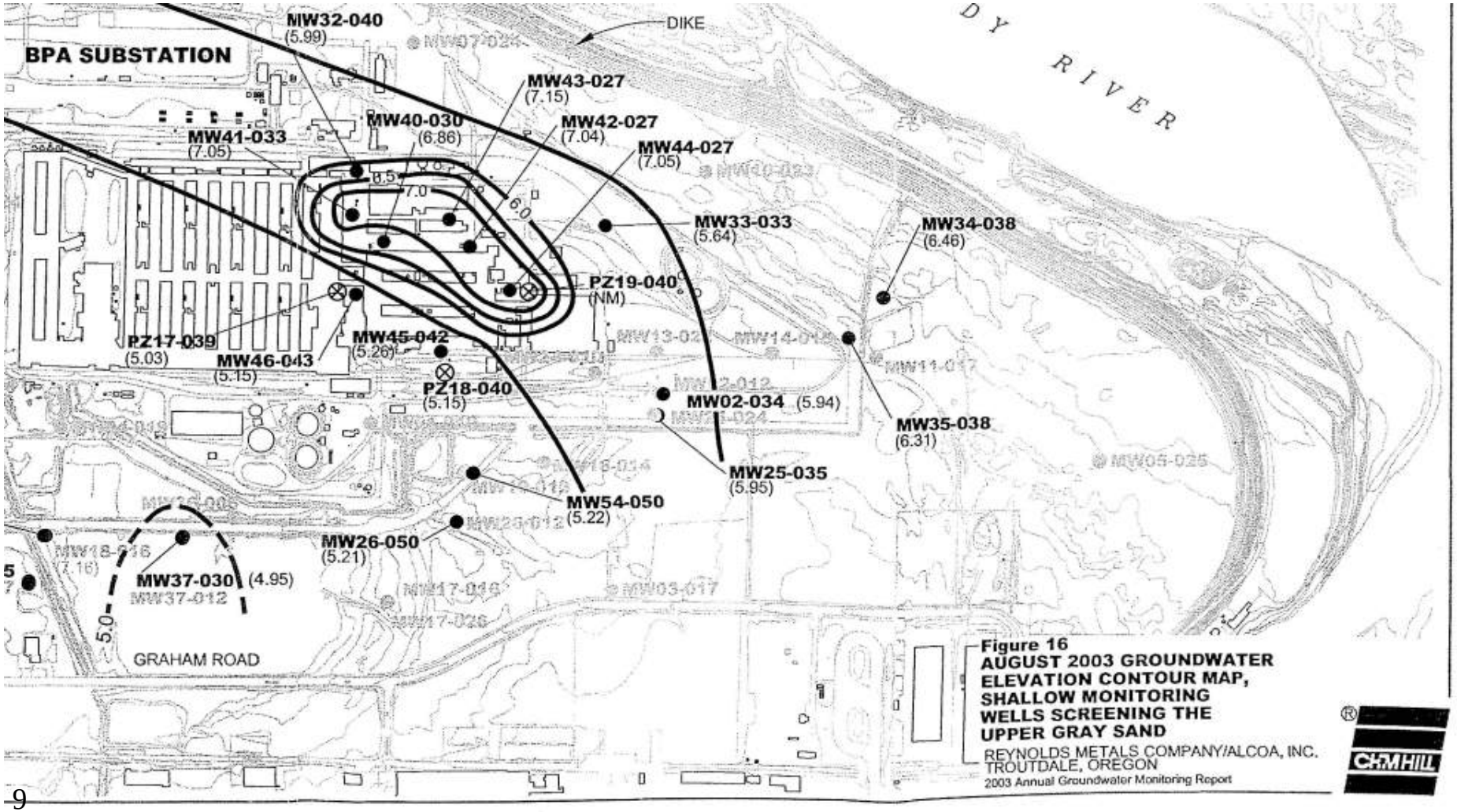
# February 2003 - UGS

*Annual Report*



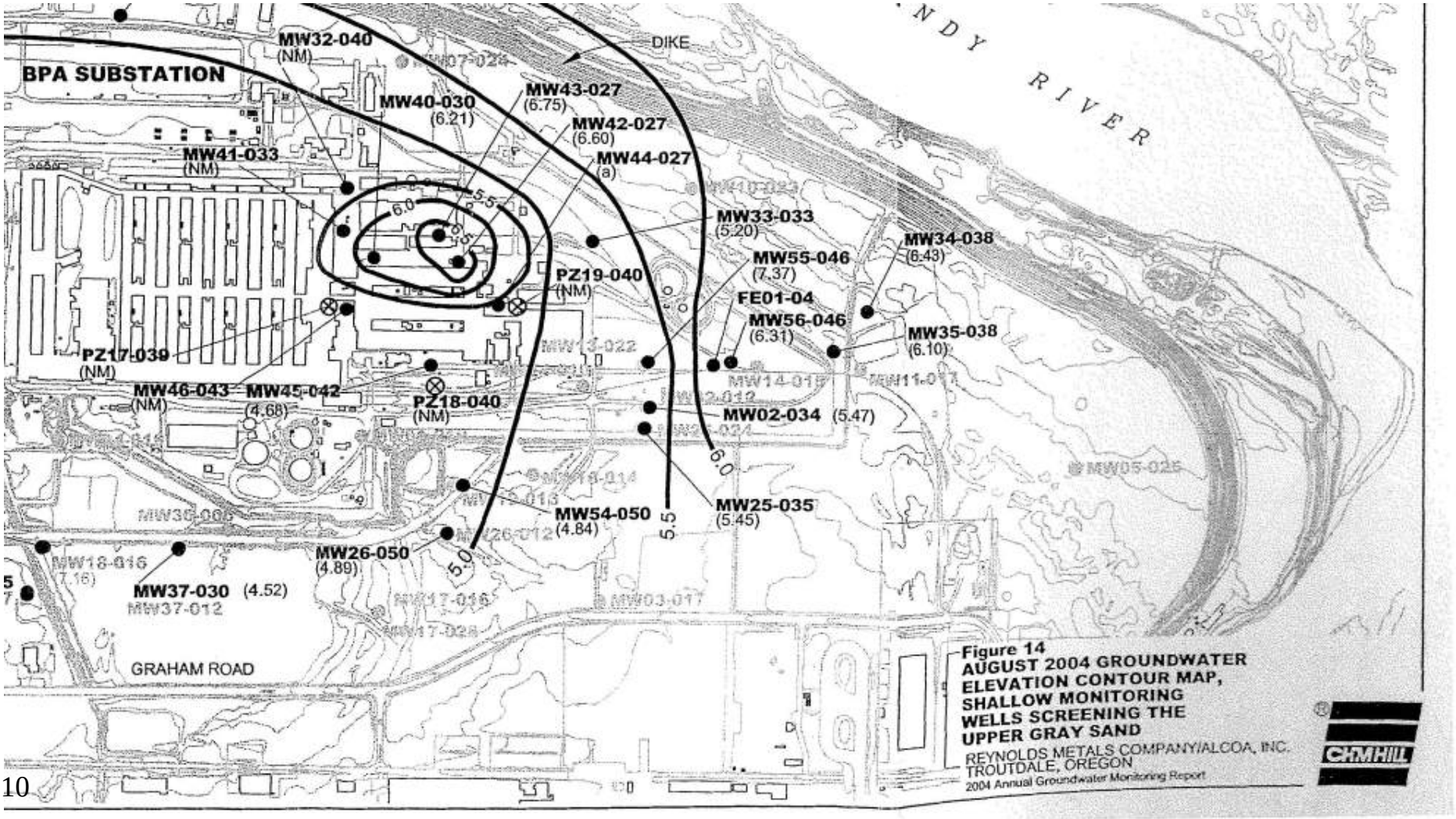
# August 2003 - UGS

*Annual Report*



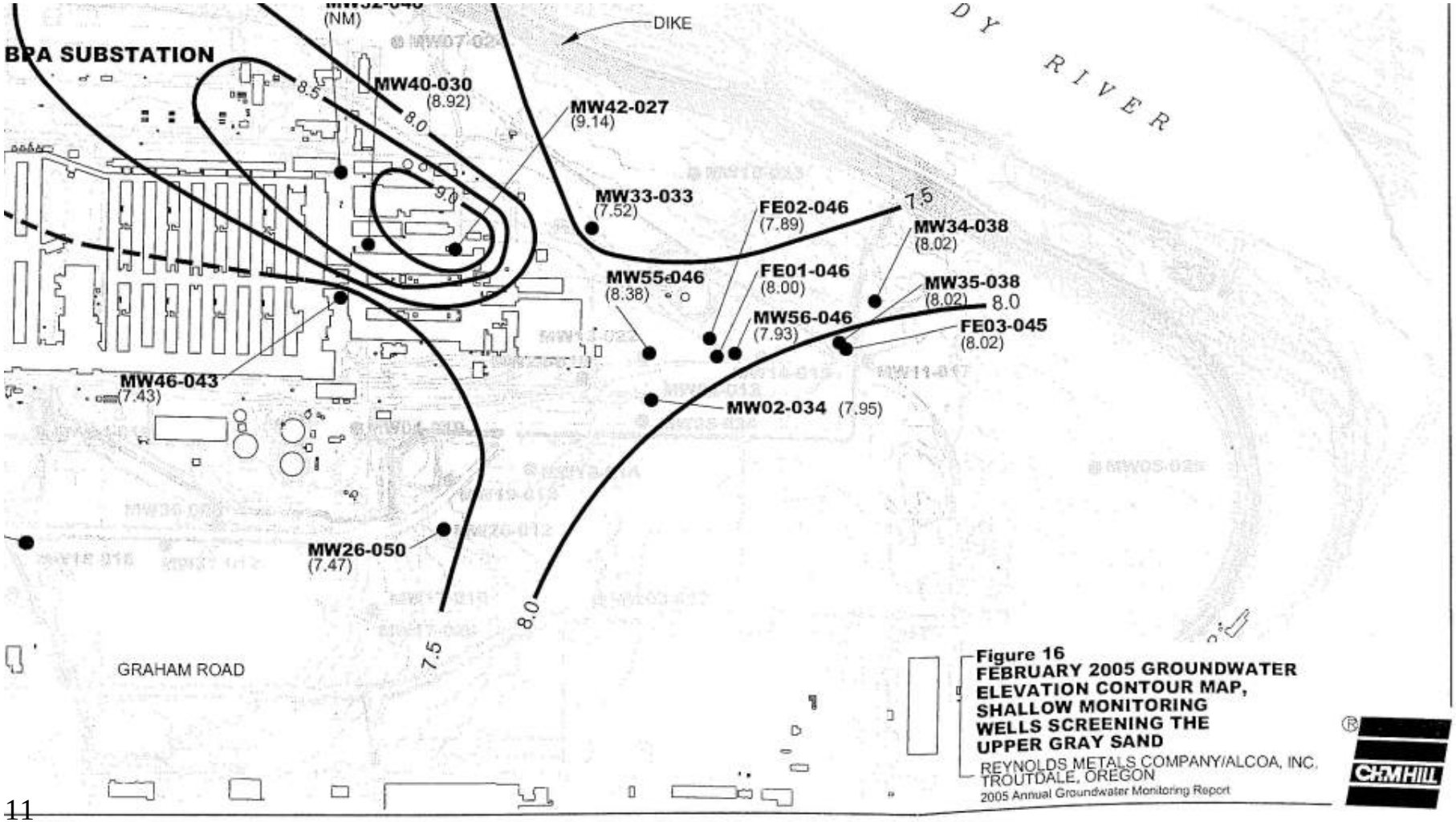
# August 2004 - UGS

*Annual Report*



# February 2005 - UGS

*Annual Report*



# August 2005 - UGS

*Annual Report*

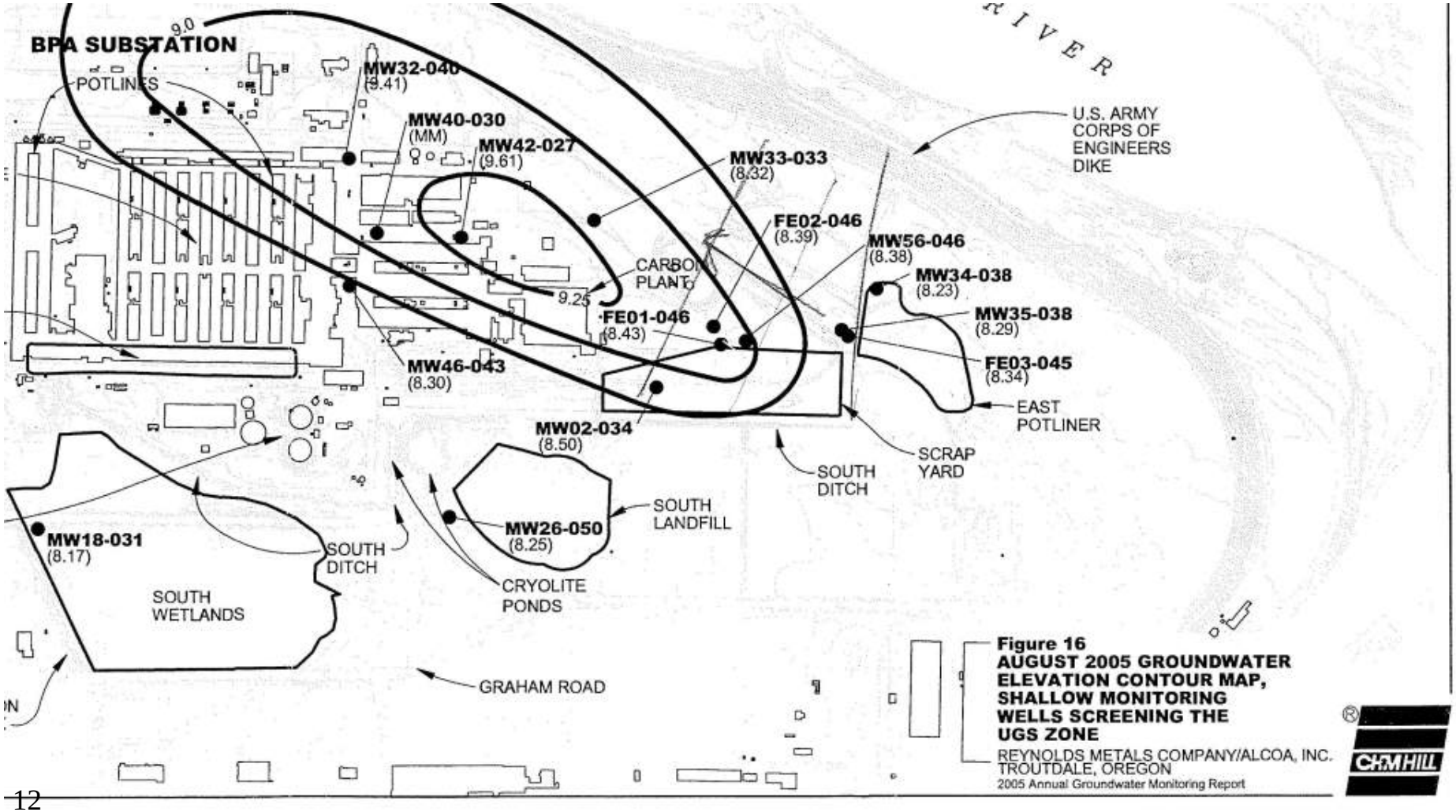
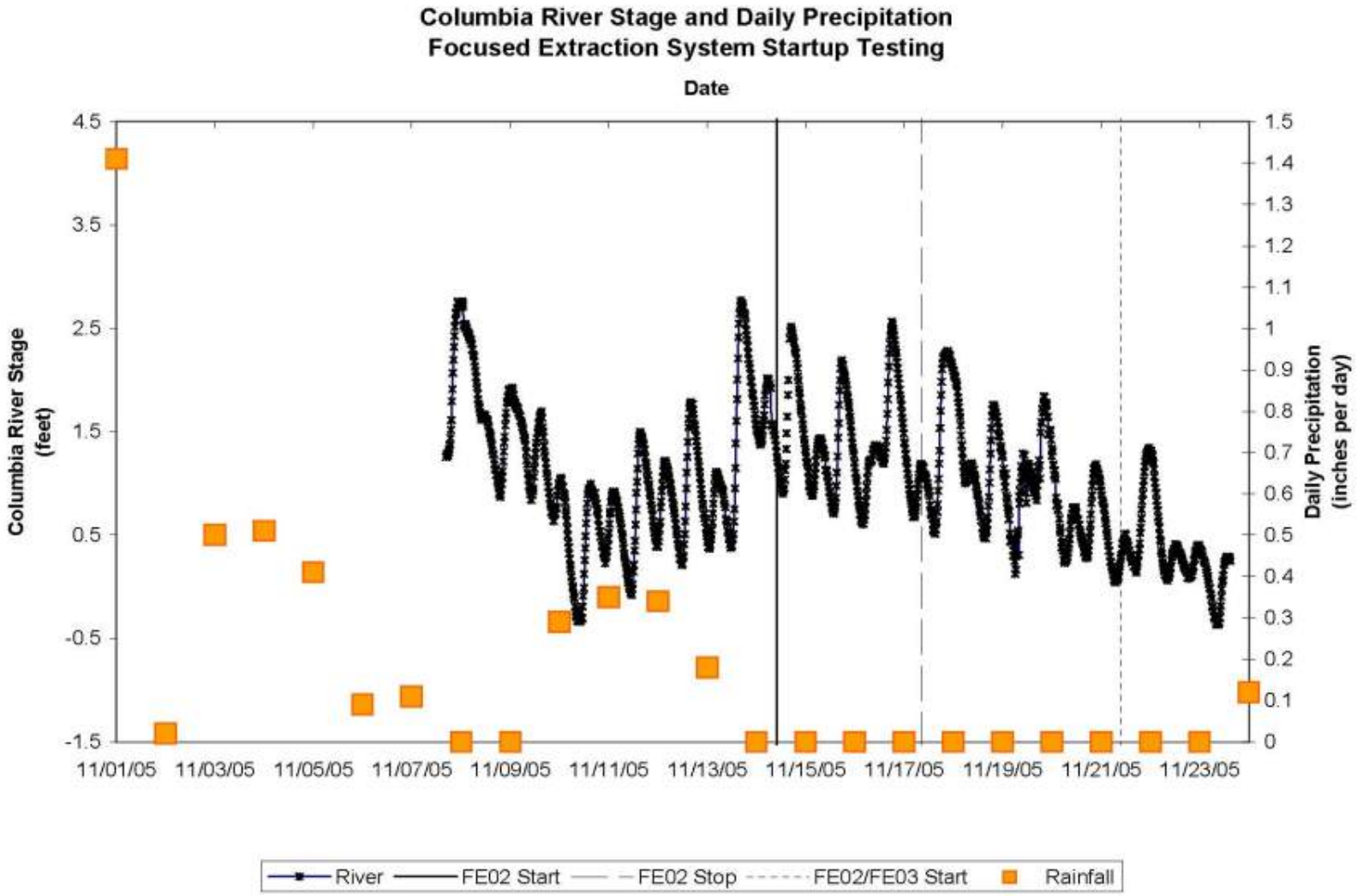
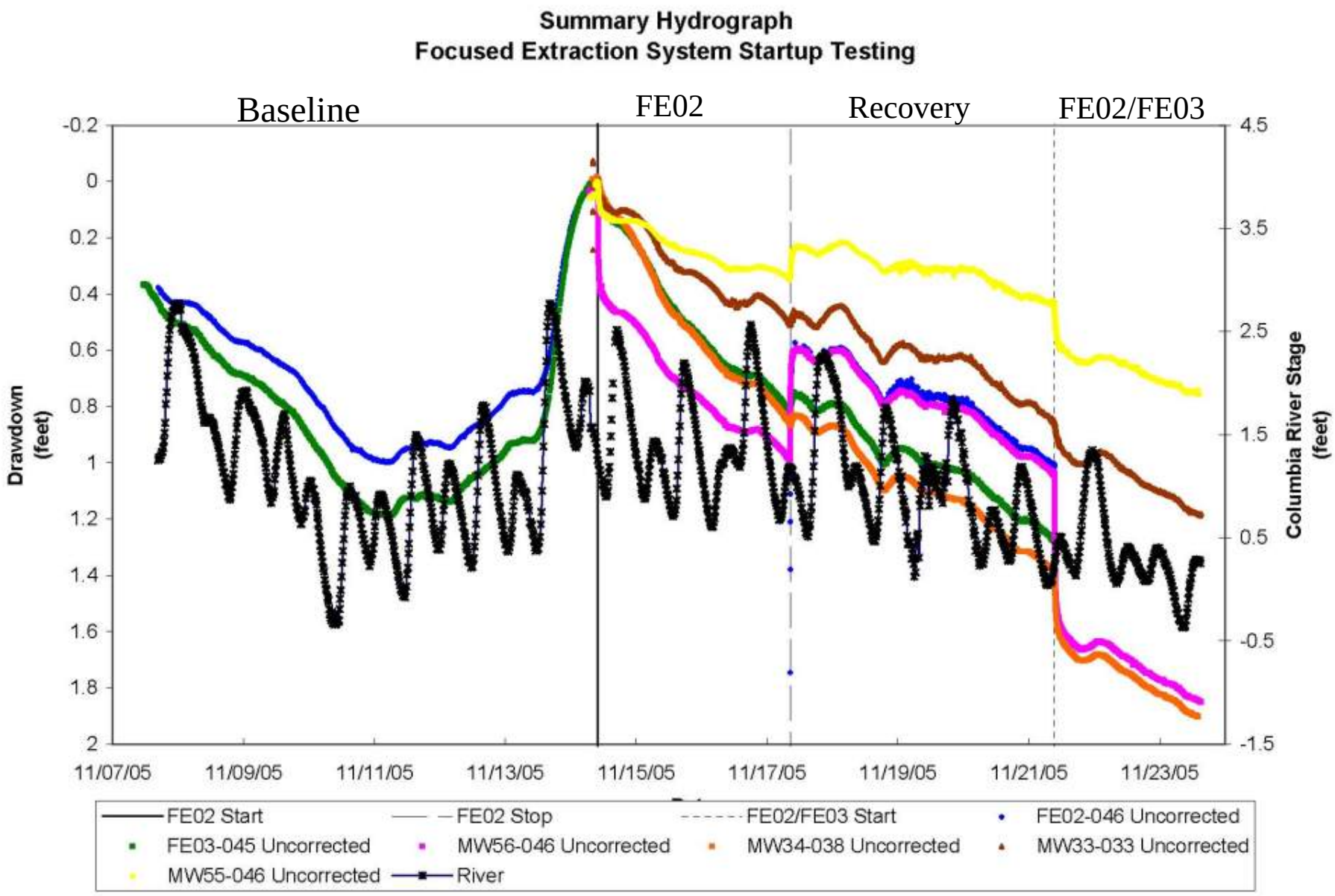
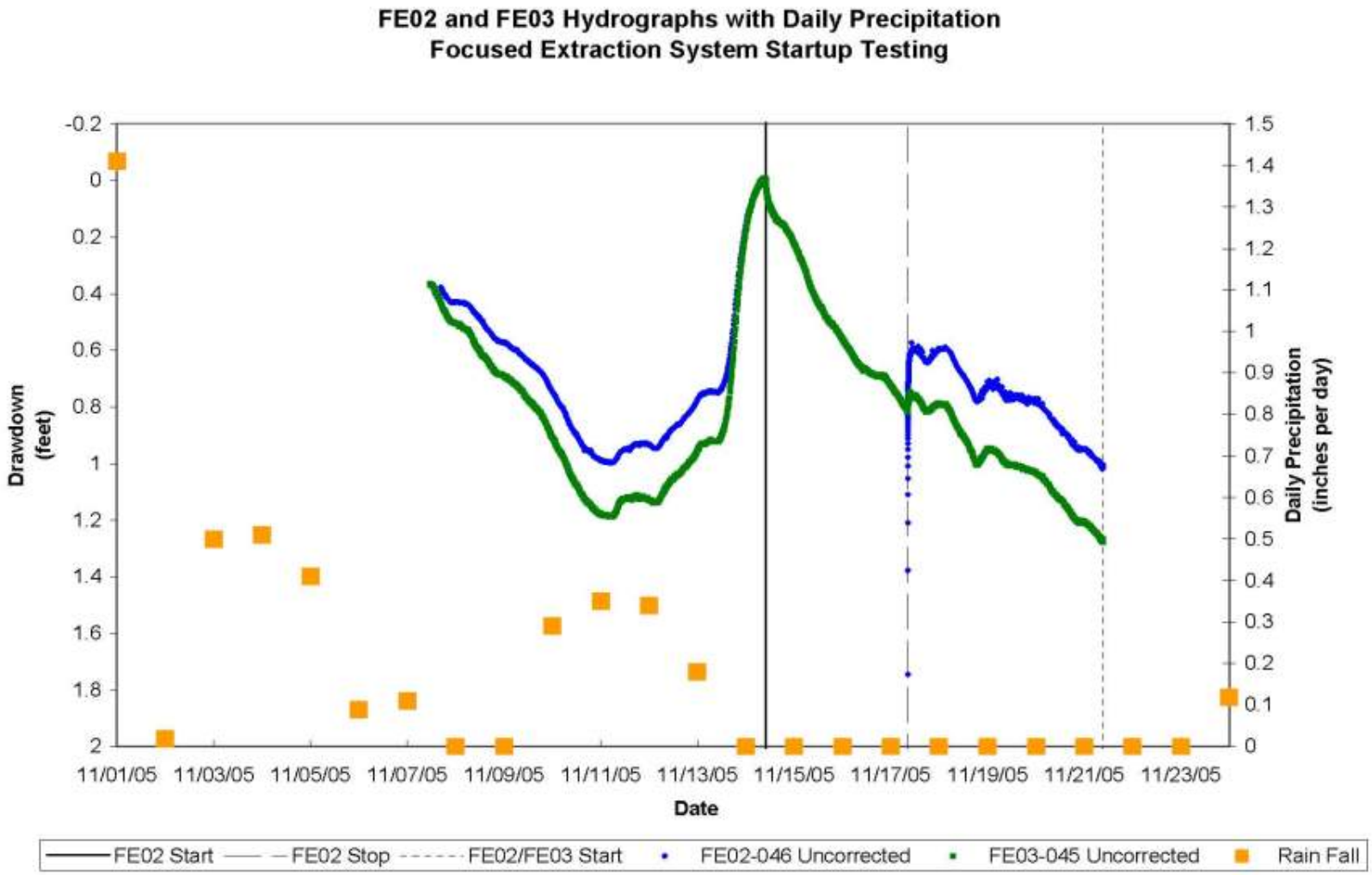


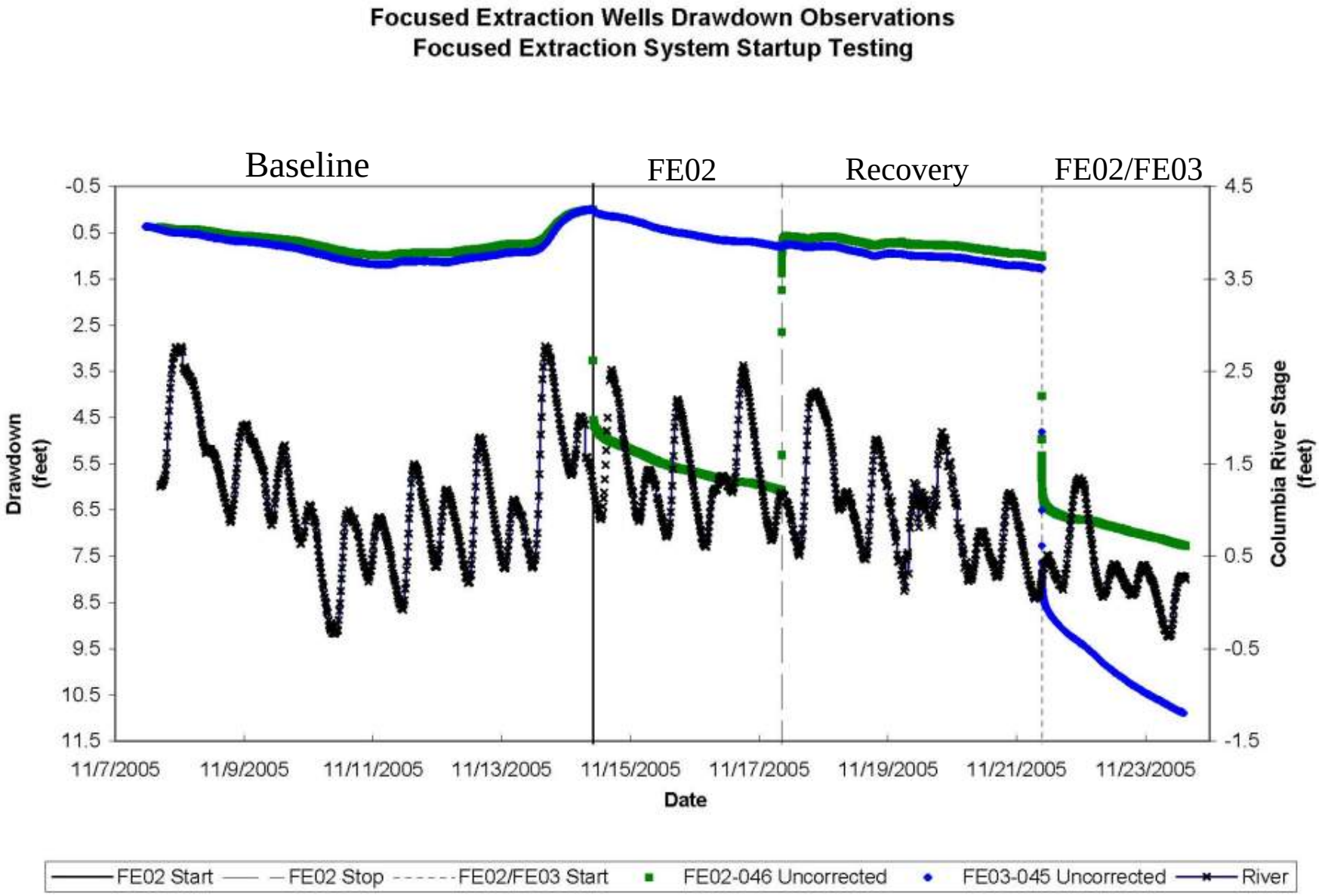

**Figure 16**
**AUGUST 2005 GROUNDWATER ELEVATION CONTOUR MAP, SHALLOW MONITORING WELLS SCREENING THE UGS ZONE**
REYNOLDS METALS COMPANY/ALCOA, INC.
TROUTDALE, OREGON
2005 Annual Groundwater Monitoring Report

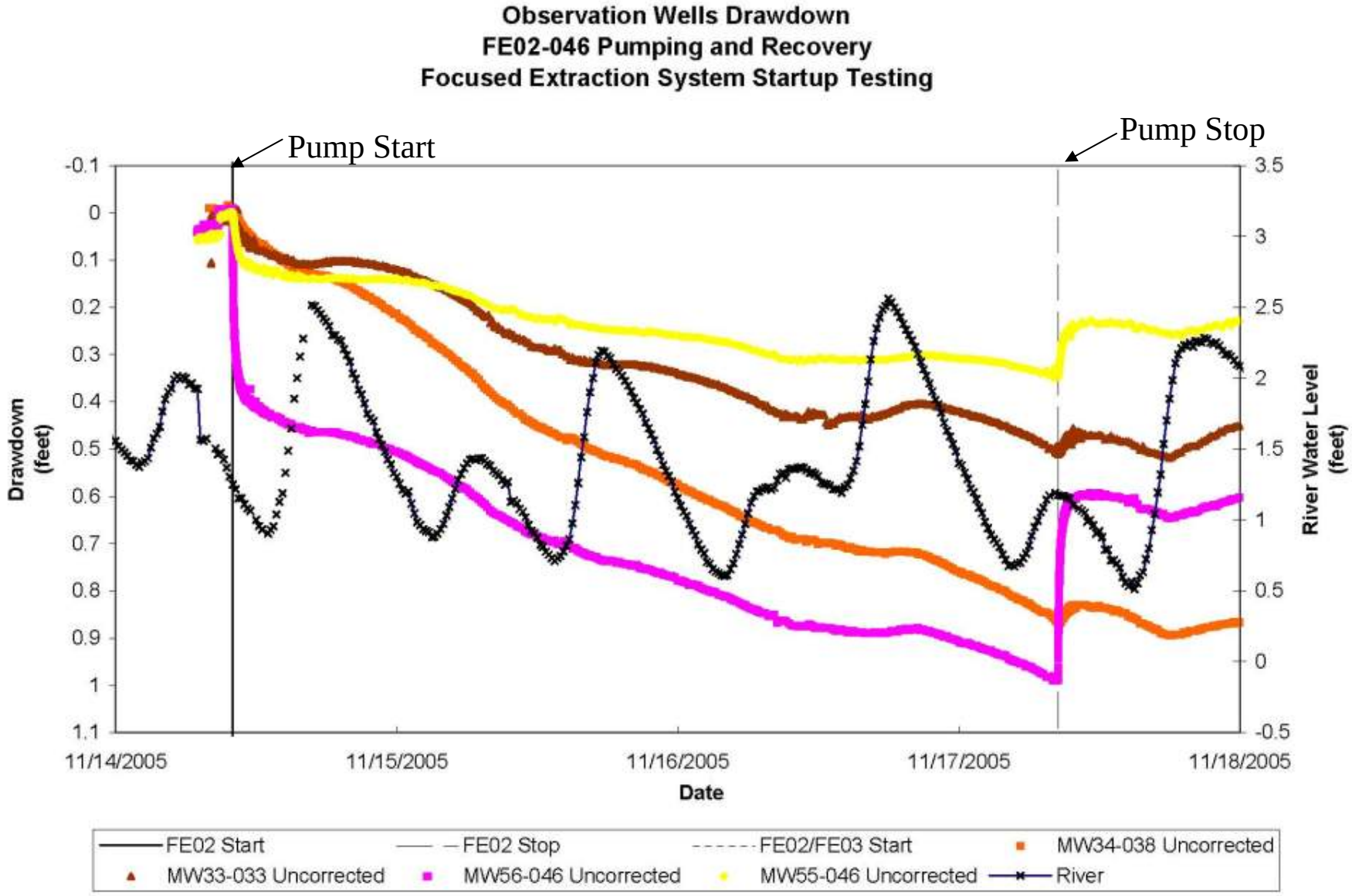
CH2MHILL

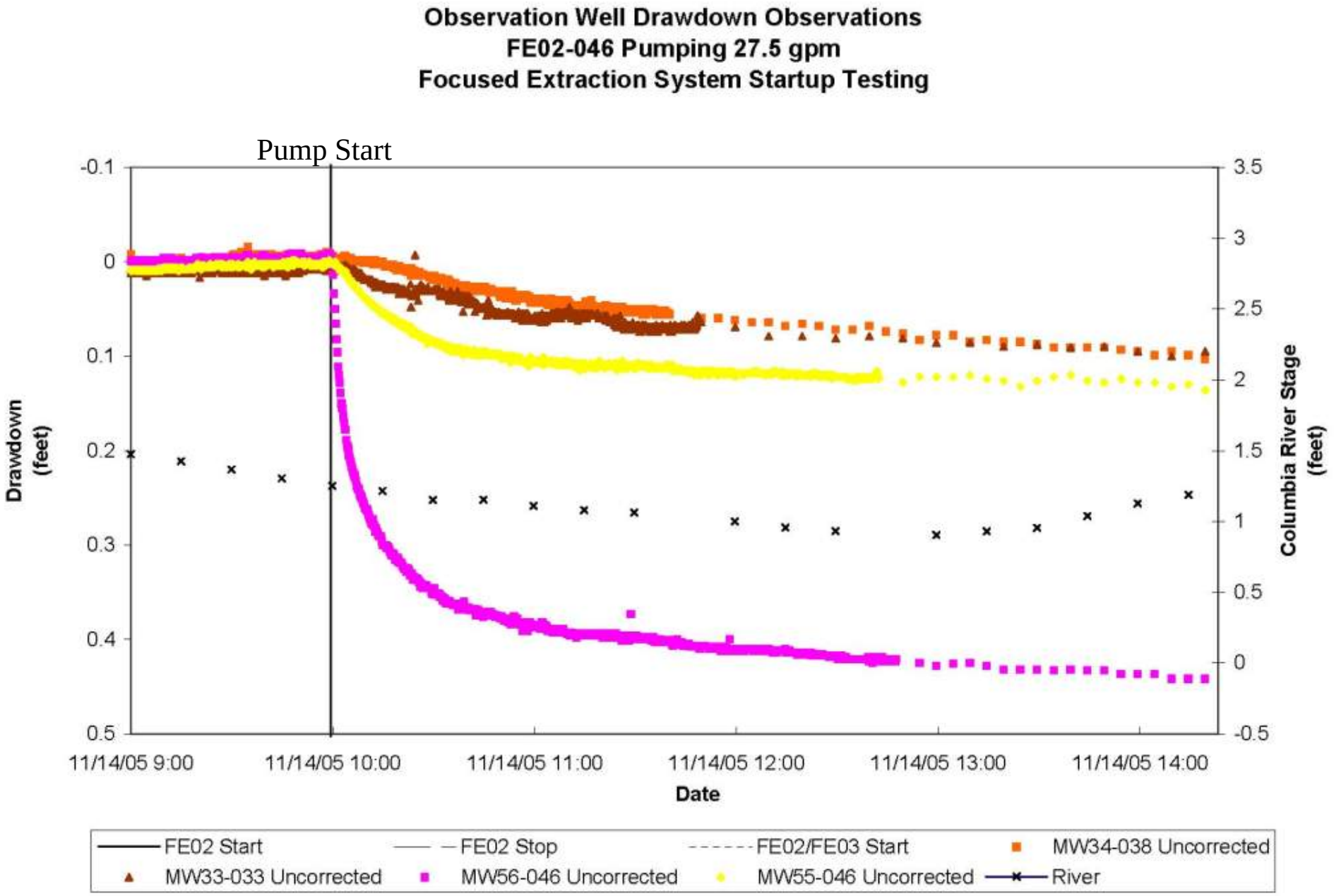

Columbia River Stage and Daily Precipitation
Focused Extraction System Startup Testing
Date
Columbia River Stage (feet)
Daily Precipitation (inches per day)
4.5
3.5
2.5
1.5
0.5
-0.5
-1.5
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
11/01/05
11/03/05
11/05/05
11/07/05
11/09/05
11/11/05
11/13/05
11/15/05
11/17/05
11/19/05
11/21/05
11/23/05
River
FE02 Start
FE02 Stop
FE02/FE03 Start
Rainfall

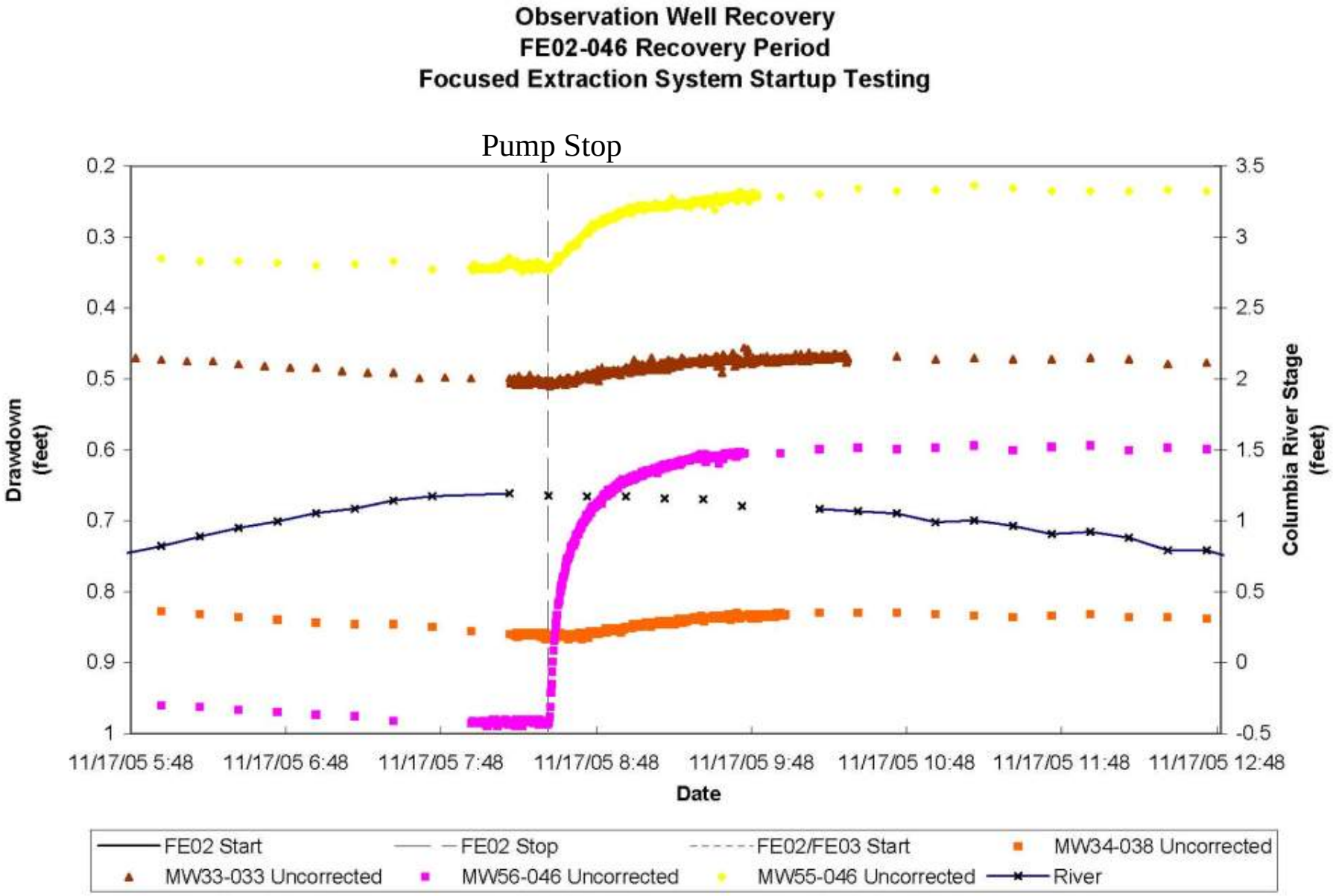

Summary Hydrograph
Focused Extraction System Startup Testing
Baseline
FE02
Recovery
FE02/FE03
Drawdown (feet)
Columbia River Stage (feet)
-0.2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4.5
3.5
2.5
1.5
0.5
-0.5
-1.5
11/07/05
11/09/05
11/11/05
11/13/05
11/15/05
11/17/05
11/19/05
11/21/05
11/23/05
FE02 Start
FE02 Stop
FE02/FE03 Start
FE02-046 Uncorrected
FE03-045 Uncorrected
MW56-046 Uncorrected
MW34-038 Uncorrected
MW33-033 Uncorrected
MW55-046 Uncorrected
River


FE02 and FE03 Hydrographs with Daily Precipitation
Focused Extraction System Startup Testing
Drawdown (feet)
-0.2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Daily Precipitation (inches per day)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
11/01/05
11/03/05
11/05/05
11/07/05
11/09/05
11/11/05
11/13/05
11/15/05
11/17/05
11/19/05
11/21/05
11/23/05
Date
FE02 Start
FE02 Stop
FE02/FE03 Start
FE02-046 Uncorrected
FE03-045 Uncorrected
Rain Fall

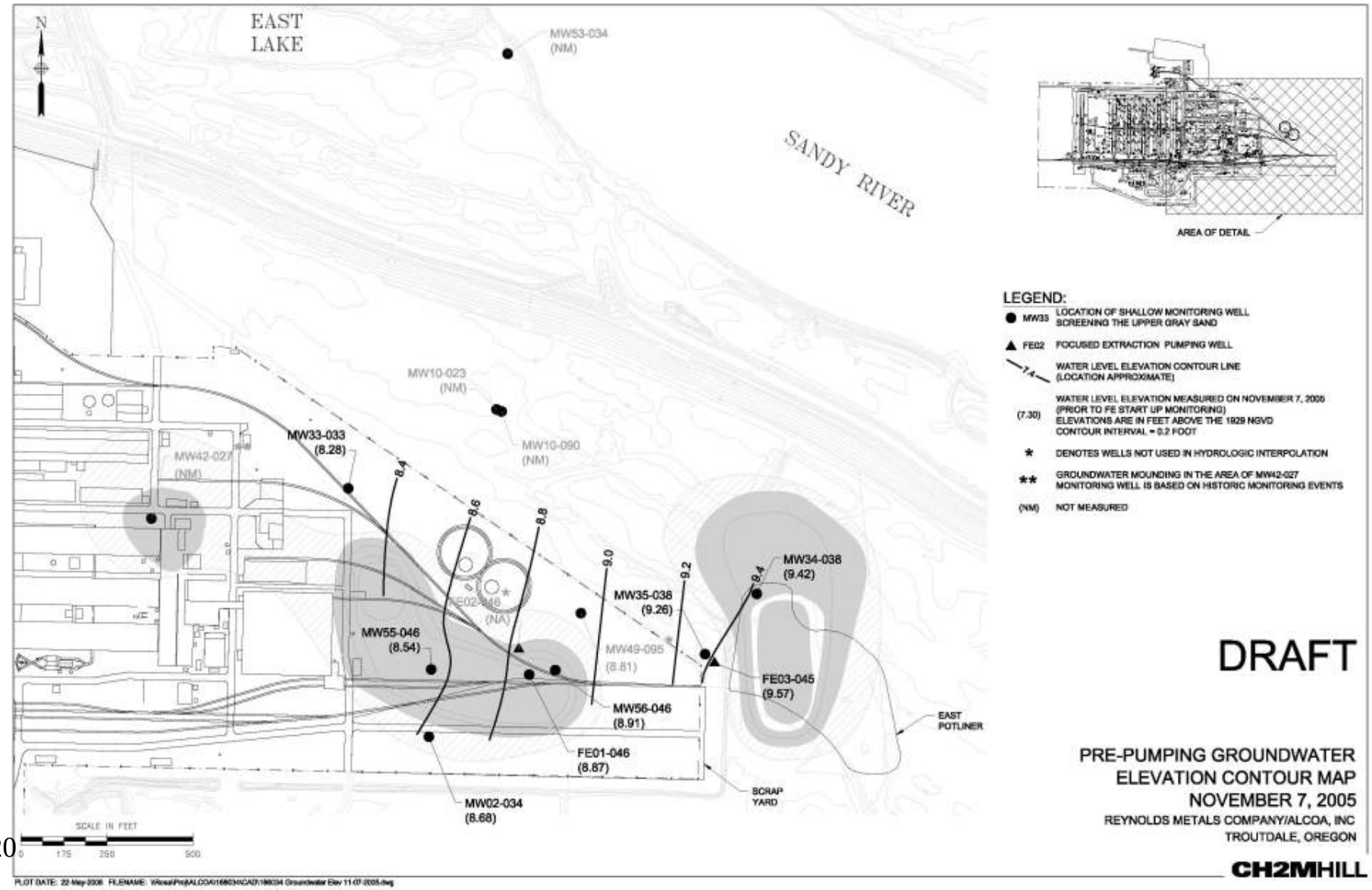

Focused Extraction Wells Drawdown Observations
Focused Extraction System Startup Testing
Baseline
FE02
Recovery
FE02/FE03
Drawdown (feet)
Columbia River Stage (feet)
-0.5
0.5
1.5
2.5
3.5
4.5
5.5
6.5
7.5
8.5
9.5
10.5
11.5
4.5
3.5
2.5
1.5
0.5
-0.5
-1.5
11/7/2005
11/9/2005
11/11/2005
11/13/2005
11/15/2005
11/17/2005
11/19/2005
11/21/2005
11/23/2005
Date
FE02 Start
FE02 Stop
FE02/FE03 Start
FE02-046 Uncorrected
FE03-045 Uncorrected
River


Observation Wells Drawdown
FE02-046 Pumping and Recovery
Focused Extraction System Startup Testing
Pump Start
Pump Stop
Drawdown (feet)
River Water Level (feet)
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
11/14/2005
11/15/2005
11/16/2005
11/17/2005
11/18/2005
Date
FE02 Start
FE02 Stop
FE02/FE03 Start
MW34-038 Uncorrected
MW33-033 Uncorrected
MW56-046 Uncorrected
MW55-046 Uncorrected
River

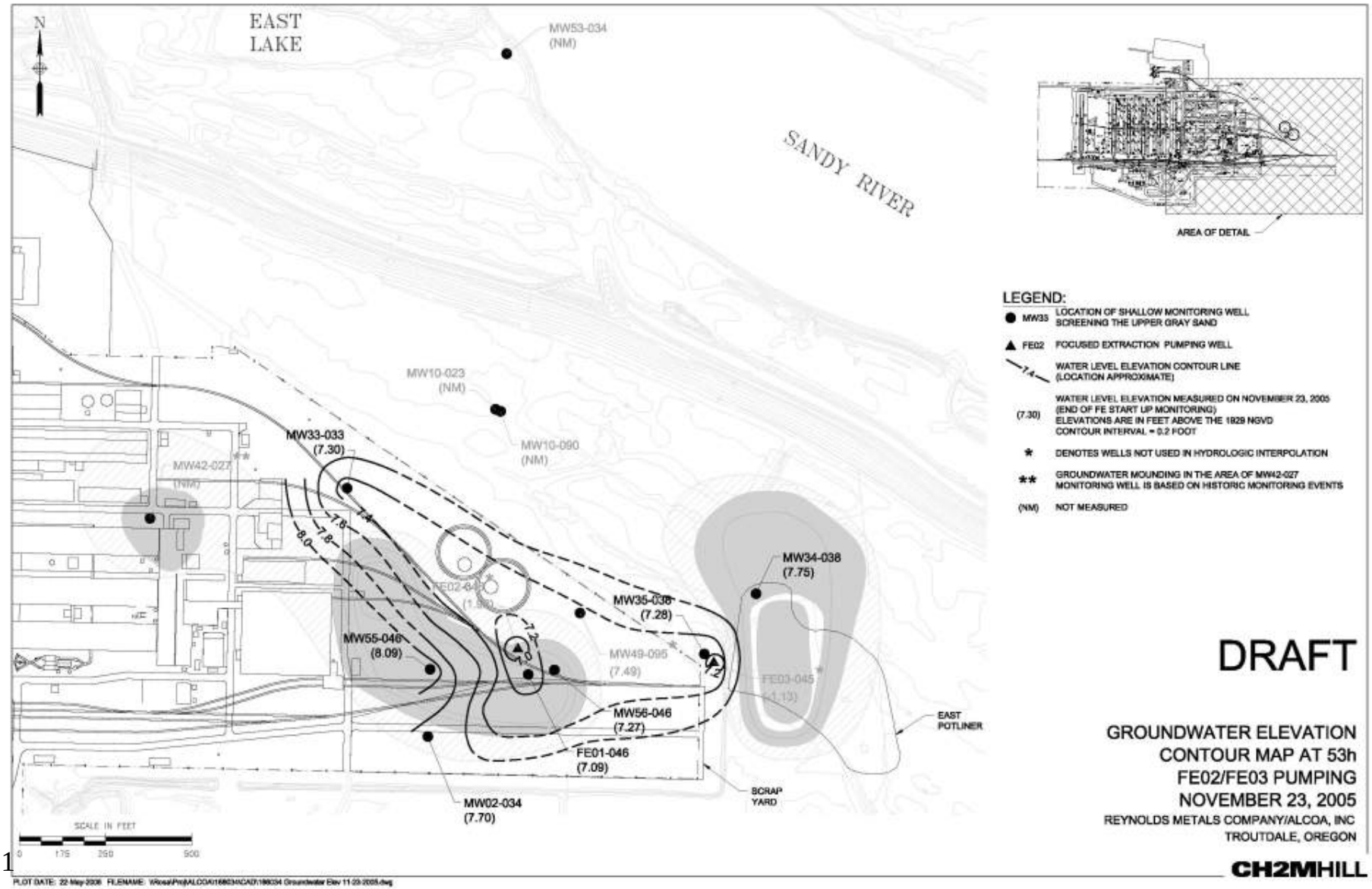

Observation Well Drawdown Observations
FE02-046 Pumping 27.5 gpm
Focused Extraction System Startup Testing
Pump Start
Drawdown (feet)
Columbia River Stage (feet)
-0.1
0
0.1
0.2
0.3
0.4
0.5
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
11/14/05 9:00
11/14/05 10:00
11/14/05 11:00
11/14/05 12:00
11/14/05 13:00
11/14/05 14:00
Date
FE02 Start
FE02 Stop
FE02/FE03 Start
MW34-038 Uncorrected
MW33-033 Uncorrected
MW56-046 Uncorrected
MW55-046 Uncorrected
River


Observation Well Recovery
FE02-046 Recovery Period
Focused Extraction System Startup Testing
Pump Stop
Drawdown (feet)
Columbia River Stage (feet)
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
11/17/05 5:48
11/17/05 6:48
11/17/05 7:48
11/17/05 8:48
11/17/05 9:48
11/17/05 10:48
11/17/05 11:48
11/17/05 12:48
Date
FE02 Start
FE02 Stop
FE02/FE03 Start
MW34-038 Uncorrected
MW33-033 Uncorrected
MW56-046 Uncorrected
MW55-046 Uncorrected
River

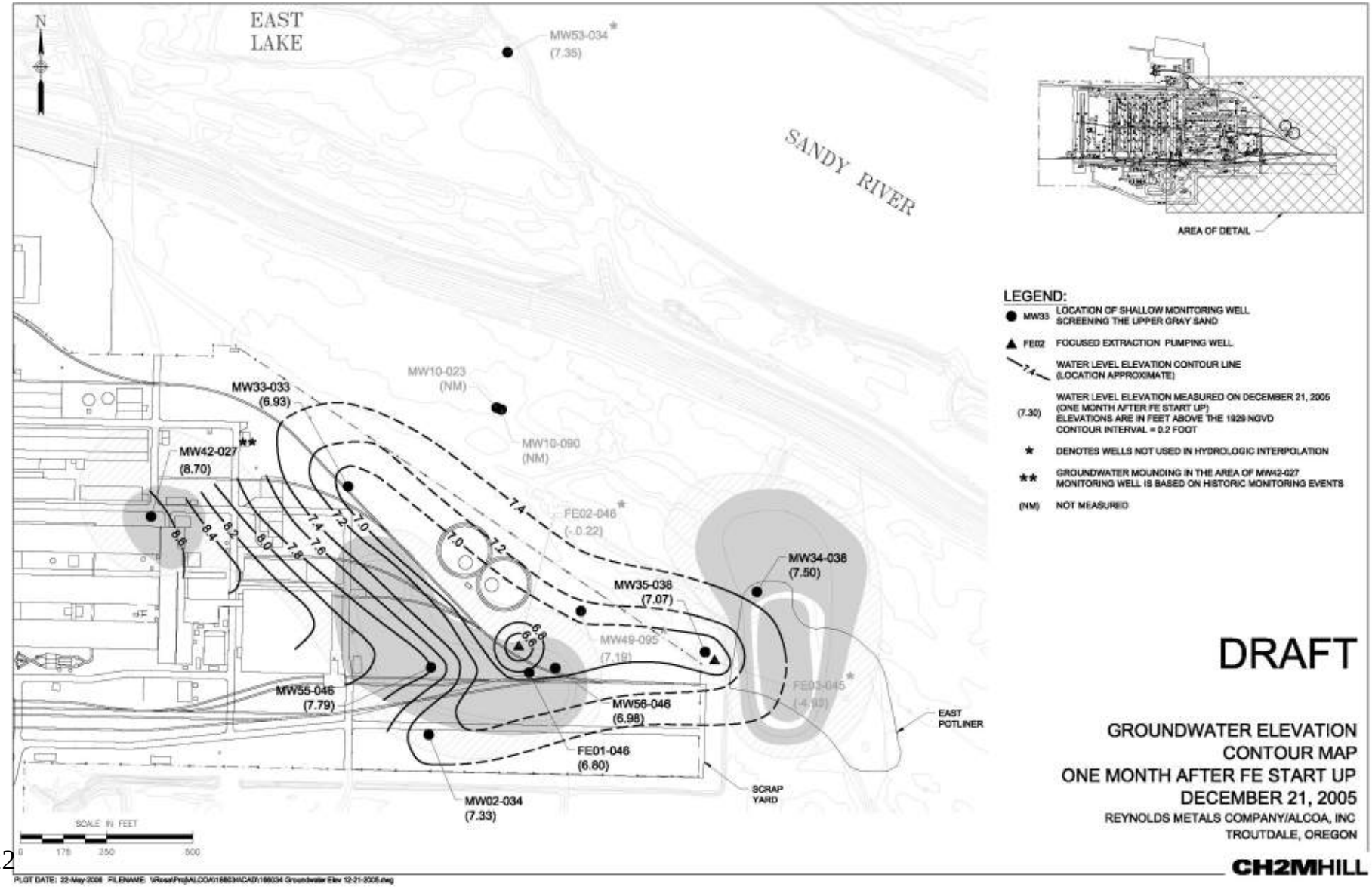
# Pre-Pumping (November 2005)



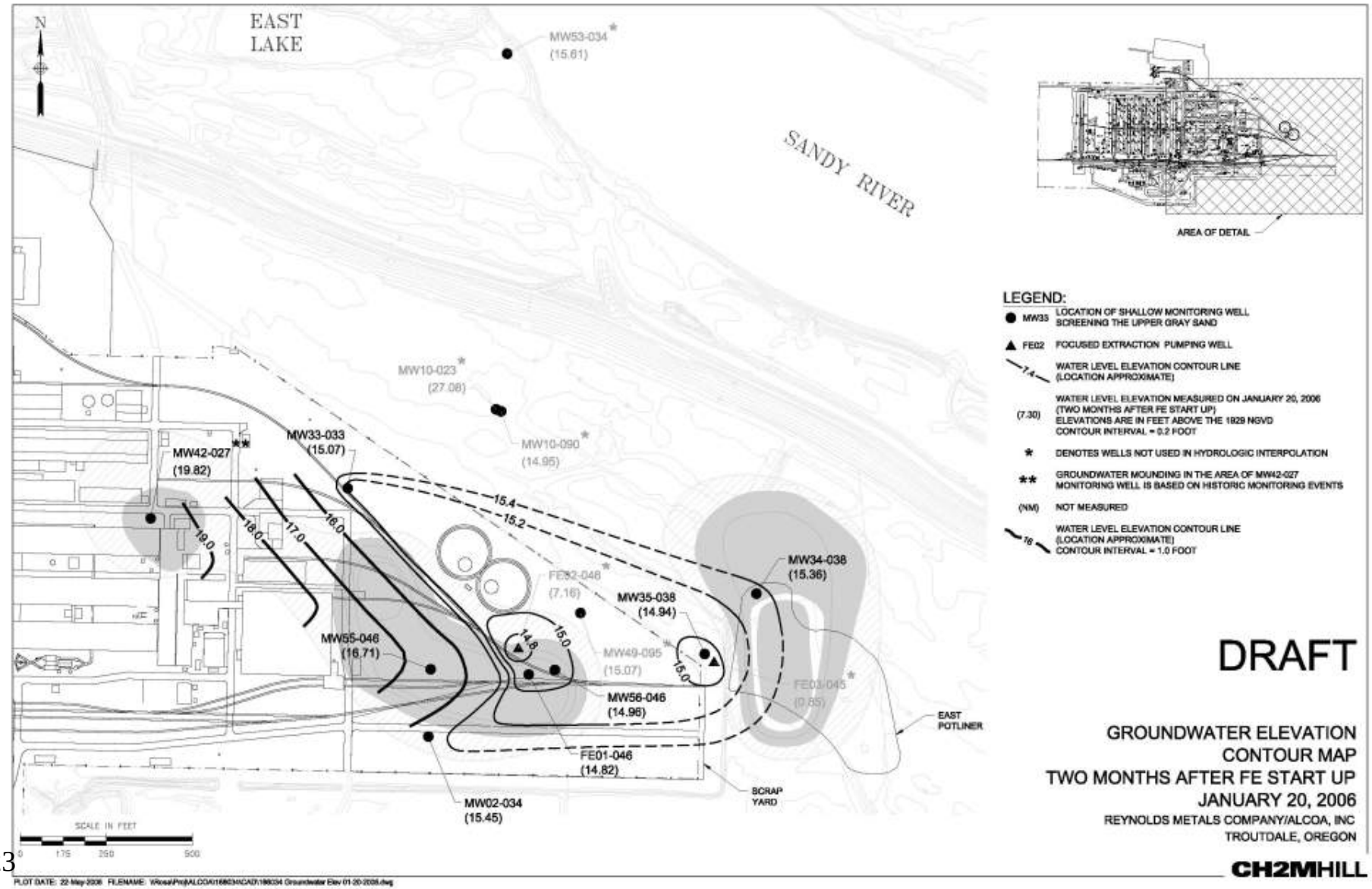
# 53 hr (November 2005)


N
EAST LAKE
SANDY RIVER
MW53-034 (NM)
MW10-023 (NM)
MW10-090 (NM)
MW42-027 (NM)
MW33-033 (7.30)
MW34-038 (7.75)
MW35-038 (7.28)
MW55-046 (8.09)
MW49-095 (7.49)
MW56-046 (7.27)
FE01-046 (7.09)
MW02-034 (7.70)
FE03-045 (7.13)
EAST POTLINER
SCRAP YARD
AREA OF DETAIL
LEGEND:
MW33 LOCATION OF SHALLOW MONITORING WELL SCREENING THE UPPER GRAY SAND
FE02 FOCUSED EXTRACTION PUMPING WELL
WATER LEVEL ELEVATION CONTOUR LINE (LOCATION APPROXIMATE)
(7.30) WATER LEVEL ELEVATION MEASURED ON NOVEMBER 23, 2005 (END OF FE START UP MONITORING) ELEVATIONS ARE IN FEET ABOVE THE 1929 NGVD CONTOUR INTERVAL = 0.2 FOOT
* DENOTES WELLS NOT USED IN HYDROLOGIC INTERPOLATION
** GROUNDWATER MOUNDING IN THE AREA OF MW42-027 MONITORING WELL IS BASED ON HISTORIC MONITORING EVENTS
(NM) NOT MEASURED
SCALE IN FEET
0 175 250 500
DRAFT
GROUNDWATER ELEVATION CONTOUR MAP AT 53h FE02/FE03 PUMPING NOVEMBER 23, 2005
REYNOLDS METALS COMPANY/ALCOA, INC
TROUTDALE, OREGON
CH2MHILL

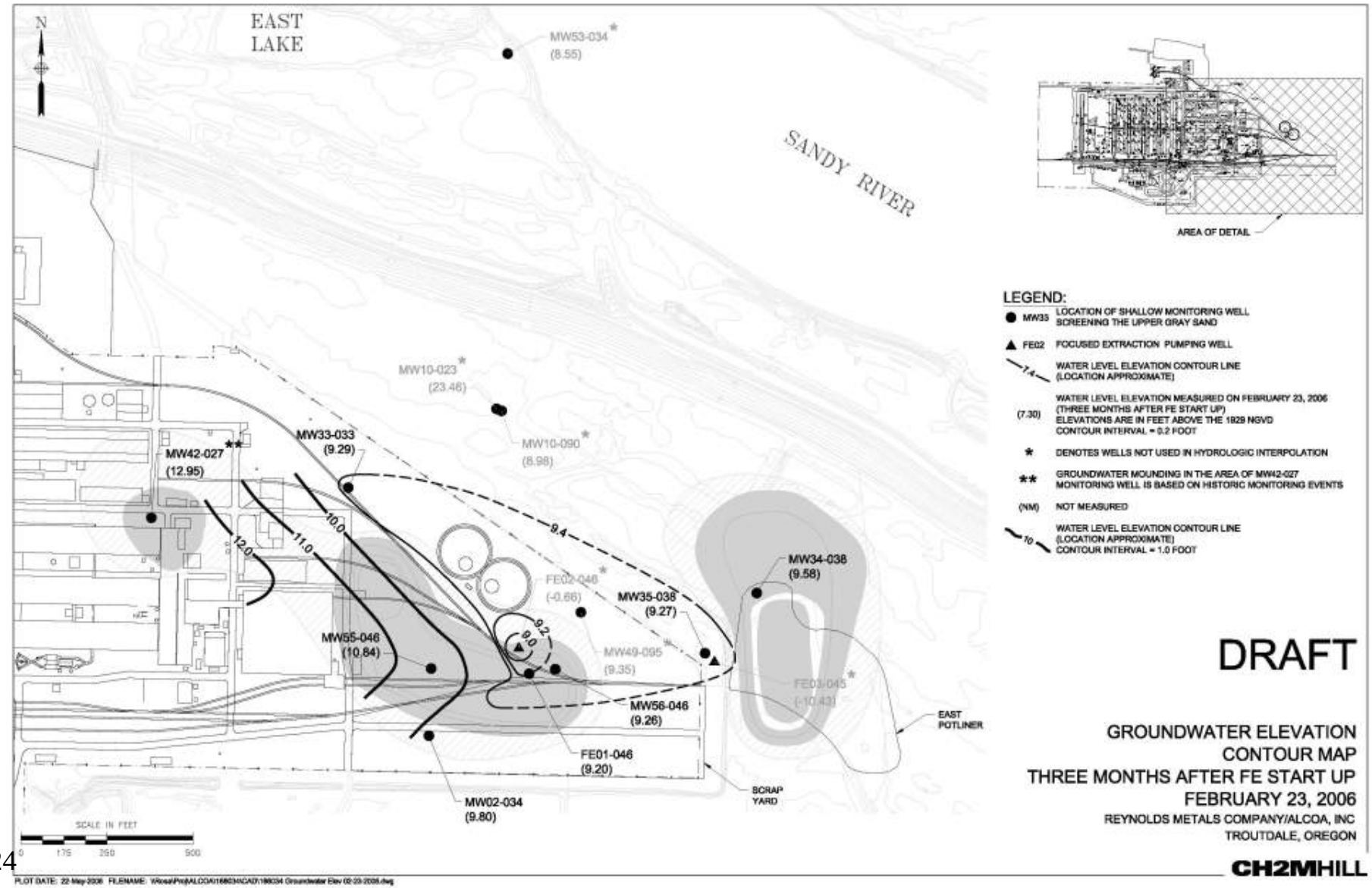
# One Month (December 2005)


N
EAST LAKE
SANDY RIVER
MW53-034 (7.35)
MW10-023 (NM)
MW10-090 (NM)
MW33-033 (6.93)
MW42-027 ** (8.70)
FE02-046 (-0.22)
MW34-038 (7.50)
MW35-038 (7.07)
MW49-095 (7.19)
FE03-045 (-4.19)
MW55-046 (7.79)
MW56-046 (6.98)
FE01-046 (6.80)
MW02-034 (7.33)
EAST POTLINER
SCRAP YARD
SCALE IN FEET
0 175 350 500
AREA OF DETAIL
LEGEND:
MW33 LOCATION OF SHALLOW MONITORING WELL SCREENING THE UPPER GRAY SAND
FE02 FOCUSED EXTRACTION PUMPING WELL
7.4 WATER LEVEL ELEVATION CONTOUR LINE (LOCATION APPROXIMATE)
(7.30) WATER LEVEL ELEVATION MEASURED ON DECEMBER 21, 2005 (ONE MONTH AFTER FE START UP) ELEVATIONS ARE IN FEET ABOVE THE 1929 NGVD CONTOUR INTERVAL = 0.2 FOOT
★ DENOTES WELLS NOT USED IN HYDROLOGIC INTERPOLATION
** GROUNDWATER MOUNDING IN THE AREA OF MW42-027 MONITORING WELL IS BASED ON HISTORIC MONITORING EVENTS
(NM) NOT MEASURED
DRAFT
GROUNDWATER ELEVATION CONTOUR MAP
ONE MONTH AFTER FE START UP
DECEMBER 21, 2005
REYNOLDS METALS COMPANY/ALCOA, INC
TROUTDALE, OREGON
CH2MHILL

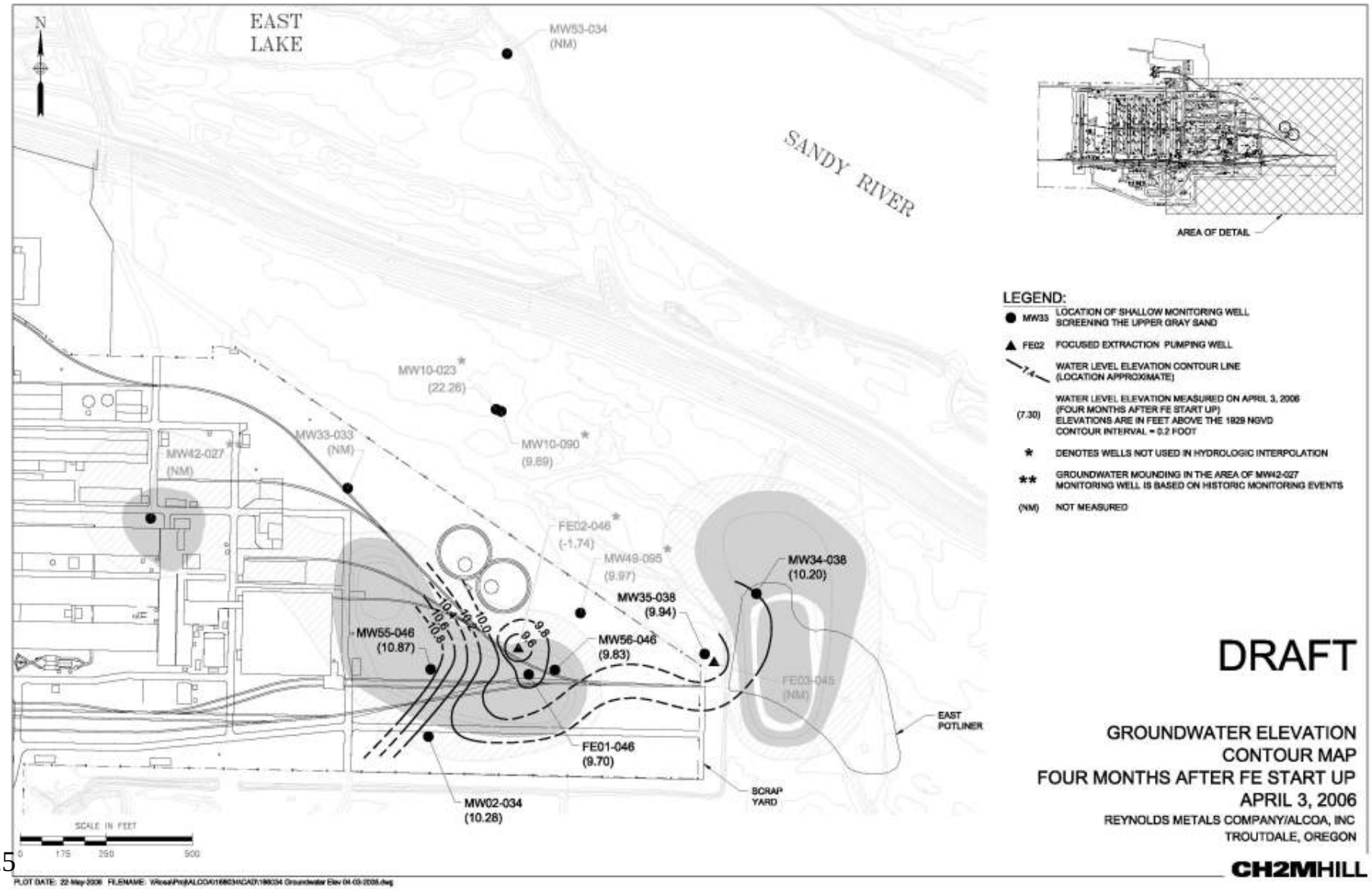
# Two Month (January 2006)


N
EAST LAKE
SANDY RIVER
MW53-034 (15.61)
MW10-023 (27.08)
MW10-090 (14.95)
MW42-027 (19.82)
MW33-033 (15.07)
MW55-046 (16.71)
MW34-038 (15.36)
MW35-038 (14.94)
MW56-046 (14.96)
MW49-095 (15.07)
FE01-046 (14.82)
MW02-034 (15.45)
EAST POTLINER
SCRAP YARD
AREA OF DETAIL
LEGEND:
MW33 LOCATION OF SHALLOW MONITORING WELL SCREENING THE UPPER GRAY SAND
FE02 FOCUSED EXTRACTION PUMPING WELL
WATER LEVEL ELEVATION CONTOUR LINE (LOCATION APPROXIMATE)
(7.30) WATER LEVEL ELEVATION MEASURED ON JANUARY 20, 2006 (TWO MONTHS AFTER FE START UP) ELEVATIONS ARE IN FEET ABOVE THE 1929 NGVD CONTOUR INTERVAL = 0.2 FOOT
* DENOTES WELLS NOT USED IN HYDROLOGIC INTERPOLATION
** GROUNDWATER MOUNDING IN THE AREA OF MW42-027 MONITORING WELL IS BASED ON HISTORIC MONITORING EVENTS
(NM) NOT MEASURED
WATER LEVEL ELEVATION CONTOUR LINE (LOCATION APPROXIMATE) CONTOUR INTERVAL = 1.0 FOOT
DRAFT
GROUNDWATER ELEVATION CONTOUR MAP
TWO MONTHS AFTER FE START UP
JANUARY 20, 2006
REYNOLDS METALS COMPANY/ALCOA, INC
TROUTDALE, OREGON
SCALE IN FEET
CH2MHILL

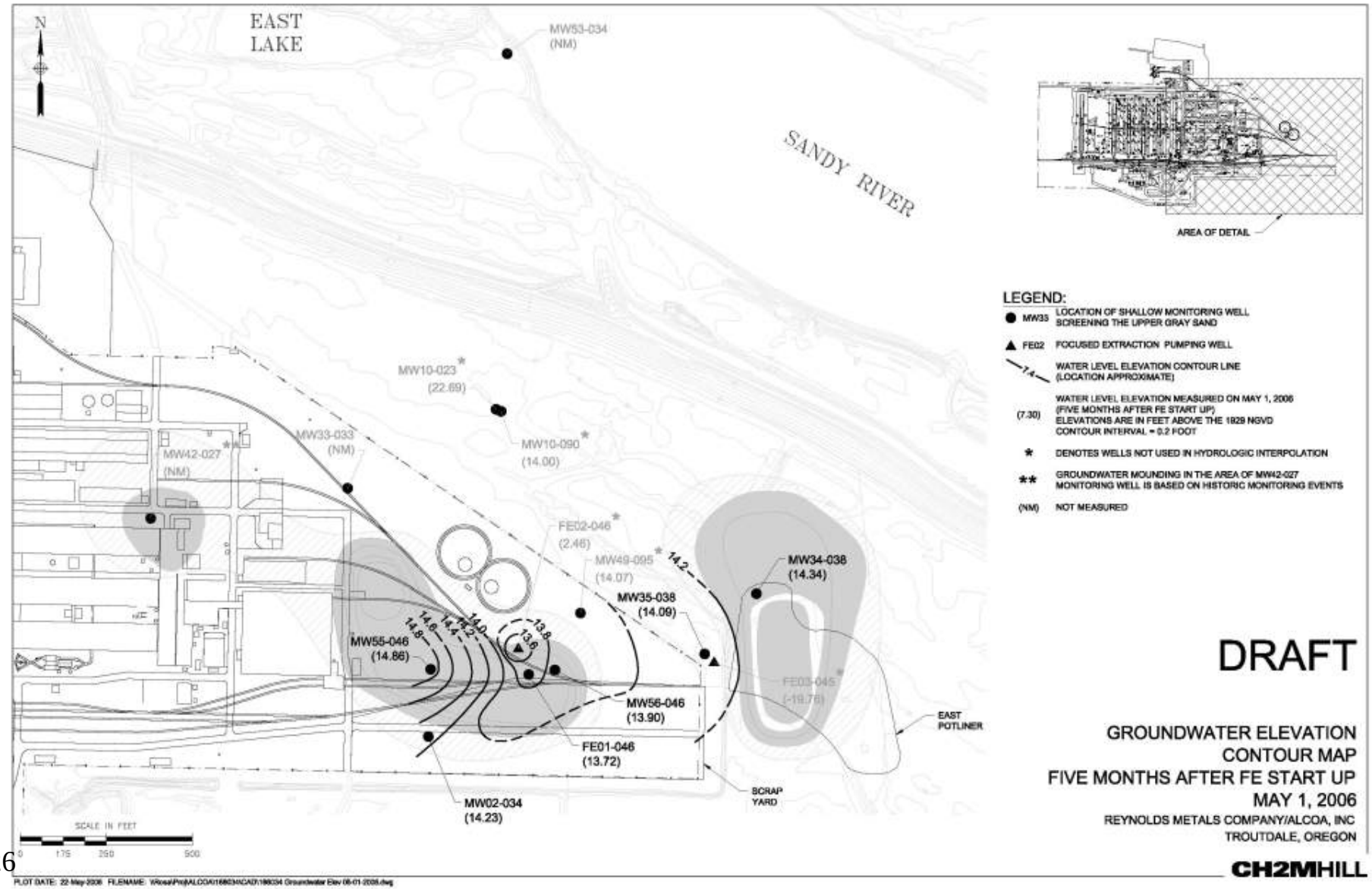
# Three Month (February 2006)



# Four Month (April 2006)


N
EAST LAKE
SANDY RIVER
MW53-034 (NM)
MW10-023* (22.26)
MW10-090* (9.69)
MW33-033 (NM)
MW42-027* (NM)
FE02-046* (-1.74)
MW49-095* (9.97)
MW34-038 (10.20)
MW35-038 (9.94)
MW55-046 (10.87)
MW56-046 (9.83)
FE03-045 (NM)
FE01-046 (9.70)
MW02-034 (10.28)
EAST POTLINER
SCRAP YARD
AREA OF DETAIL
LEGEND:
MW33 LOCATION OF SHALLOW MONITORING WELL SCREENING THE UPPER GRAY SAND
FE02 FOCUSED EXTRACTION PUMPING WELL
WATER LEVEL ELEVATION CONTOUR LINE (LOCATION APPROXIMATE)
(7.30) WATER LEVEL ELEVATION MEASURED ON APRIL 3, 2006 (FOUR MONTHS AFTER FE START UP) ELEVATIONS ARE IN FEET ABOVE THE 1929 NGVD CONTOUR INTERVAL = 0.2 FOOT
* DENOTES WELLS NOT USED IN HYDROLOGIC INTERPOLATION
** GROUNDWATER MOUNDING IN THE AREA OF MW42-027 MONITORING WELL IS BASED ON HISTORIC MONITORING EVENTS
(NM) NOT MEASURED
DRAFT
GROUNDWATER ELEVATION CONTOUR MAP
FOUR MONTHS AFTER FE START UP
APRIL 3, 2006
REYNOLDS METALS COMPANY/ALCOA, INC
TROUTDALE, OREGON
SCALE IN FEET
0 175 250 500
CH2MHILL

# Five Month (May 2006)


N
EAST LAKE
SANDY RIVER
MW53-034 (NM)
MW10-023 (22.69)
MW10-090 (14.00)
MW33-033 (NM)
MW42-027 (NM)
FE02-046 (2.46)
MW49-095 (14.07)
MW35-038 (14.09)
MW34-038 (14.34)
MW55-046 (14.86)
MW56-046 (13.90)
FE01-046 (13.72)
MW02-034 (14.23)
FE03-045 (-19.76)
EAST POTLINER
SCRAP YARD
AREA OF DETAIL
LEGEND:
MW33 LOCATION OF SHALLOW MONITORING WELL SCREENING THE UPPER GRAY SAND
FE02 FOCUSED EXTRACTION PUMPING WELL
WATER LEVEL ELEVATION CONTOUR LINE (LOCATION APPROXIMATE)
(7.30) WATER LEVEL ELEVATION MEASURED ON MAY 1, 2006 (FIVE MONTHS AFTER FE START UP) ELEVATIONS ARE IN FEET ABOVE THE 1929 NGVD CONTOUR INTERVAL = 0.2 FOOT
* DENOTES WELLS NOT USED IN HYDROLOGIC INTERPOLATION
** GROUNDWATER MOUNDING IN THE AREA OF MW42-027 MONITORING WELL IS BASED ON HISTORIC MONITORING EVENTS
(NM) NOT MEASURED
SCALE IN FEET
0 175 250 500
DRAFT
GROUNDWATER ELEVATION CONTOUR MAP
FIVE MONTHS AFTER FE START UP
MAY 1, 2006
REYNOLDS METALS COMPANY/ALCOA, INC
TROUTDALE, OREGON
CH2MHILL

**2-Hour Drawdown Observations**
**FE02-046 Pumping**

| | | Pumping Rate (gpm) | 2 Hour Corrected Drawdown (feet) |
|---|---|---|---|
| Pumping Well | | | |
| | FE02-046 | 27.5 | 4.80 |
| Observation Wells | | | |
| | FE03-045 | | 0.07 |
| | MW56-046 | | 0.40 |
| | MW55-046 | | 0.11 |
| | MW34-038 | | 0.04 |
| | MW33-033 | | 0.06 |

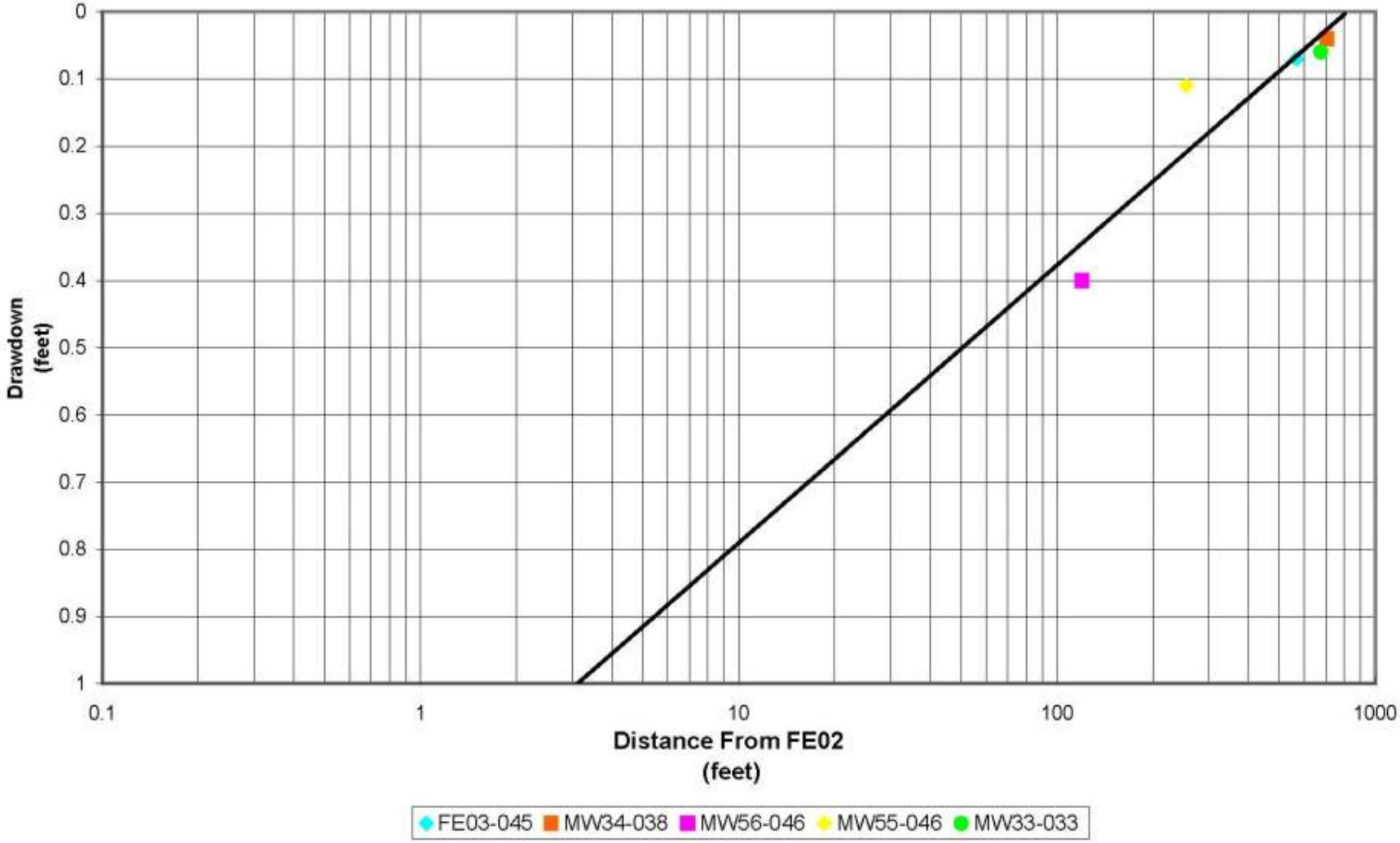
**2-Hour Recovery Observations**
**FE02-046 Pumping**

| | | Pumping Rate (gpm) | 2 Hour Corrected Drawdown (feet) |
|---|---|---|---|
| Pumping Well | | | |
| | FE02-046 | Recovery | 4.71 |
| Observation Wells | | | |
| | FE03-045 | | 0.04 |
| | MW56-046 | | 0.37 |
| | MW55-046 | | 0.11 |
| | MW34-038 | | 0.02 |
| | MW33-033 | | 0.02 |

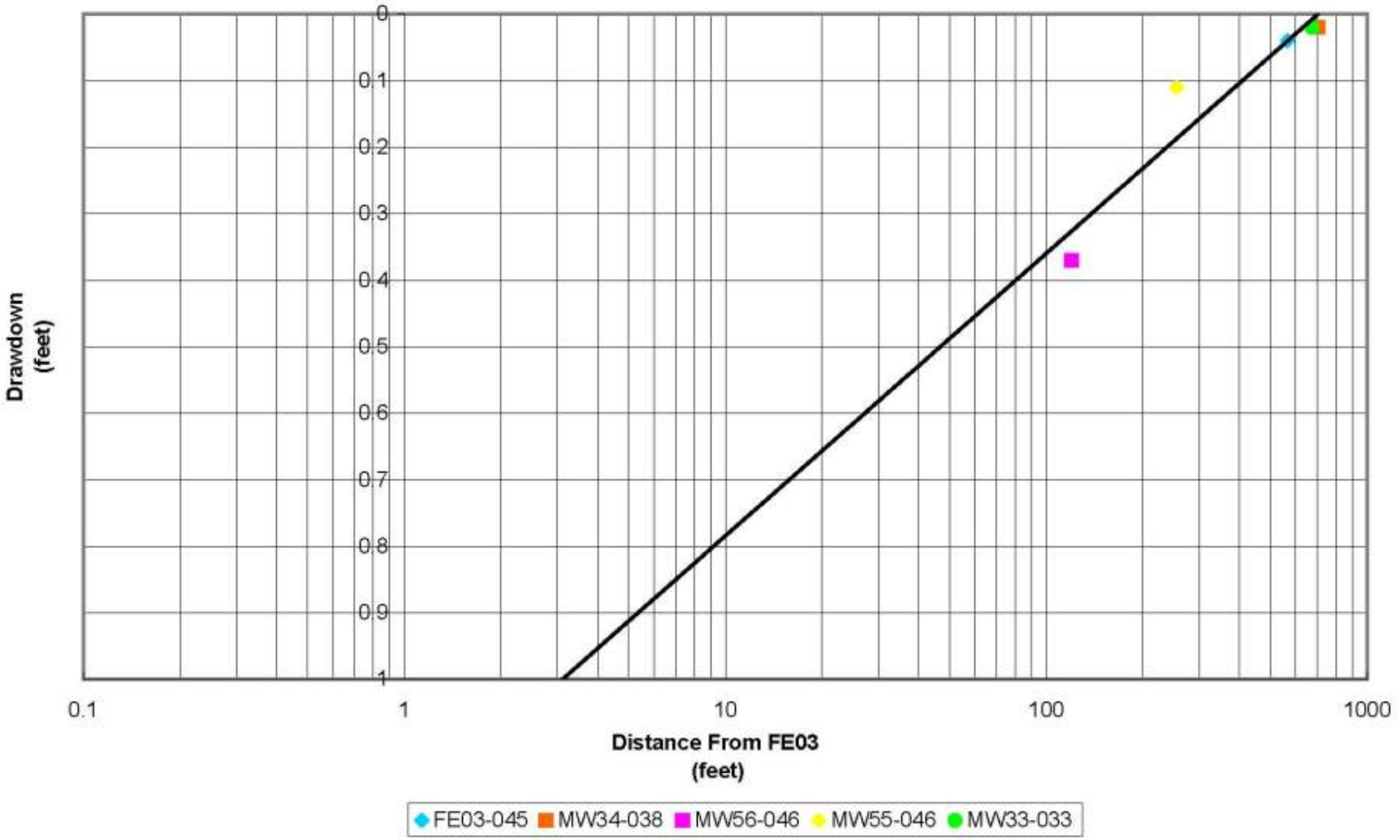
**Drawdown Observations**
**FE02-046 and FE03-045 Pumping**

| | | Pumping Rate (gpm) | 2 Hour Corrected Drawdown (feet) |
|---|---|---|---|
| Pumping Wells | | | |
| | FE02-046 | 27.5 | 5.42 |
| | FE03-045 | 28.7 | 7.34 |
| Observation Wells | | | |
| | FE01-046 | | 0.58 |
| | MW56-046 | | 0.52 |
| | MW55-046 | | 0.15 |
| | MW34-038 | | 0.21 |
| | MW33-033 | | 0.07 |

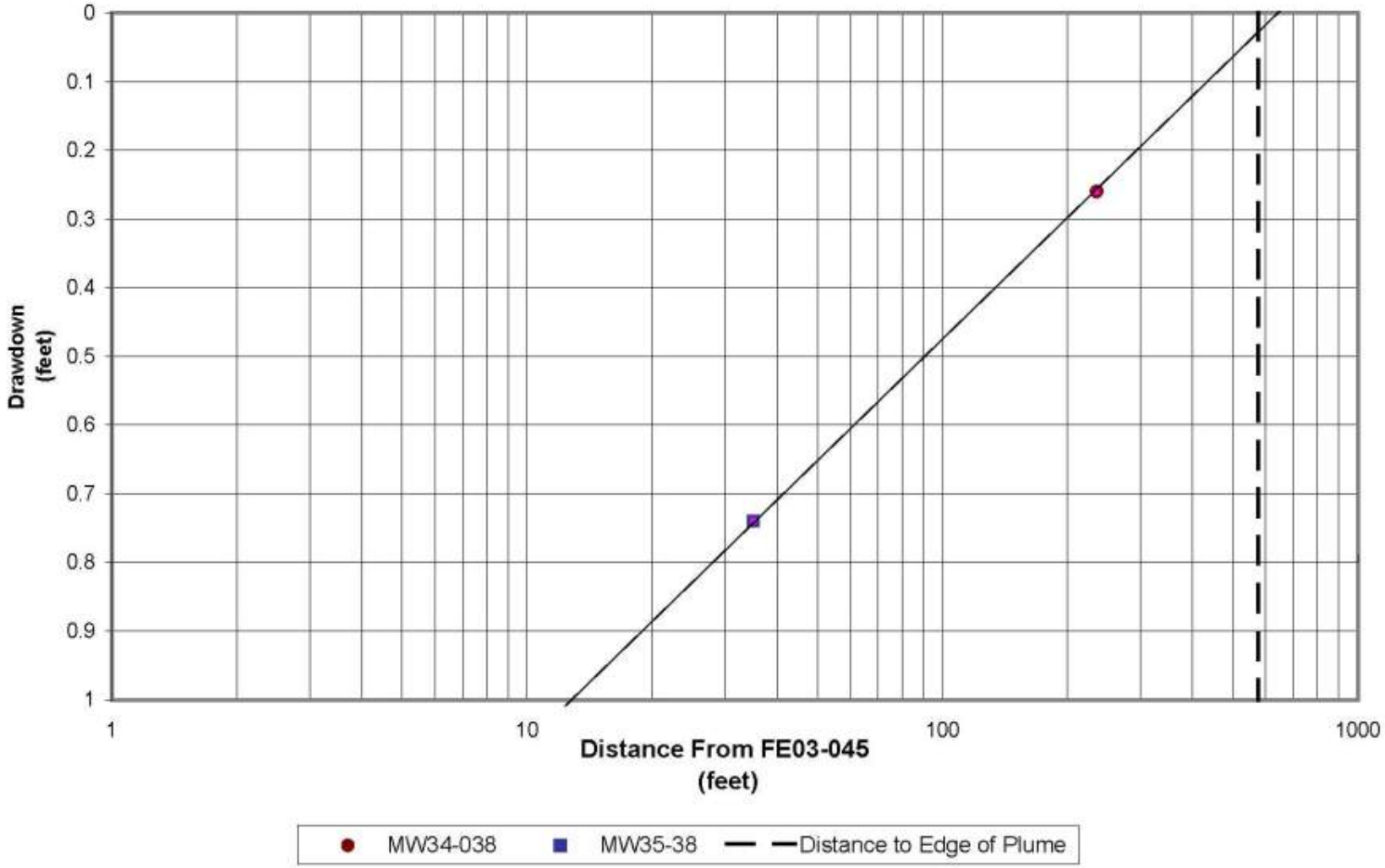
**2 Hours FE02 Drawdown**
**Straight Line Distance Drawdown Plot**
**Focused Extraction Startup Testing**



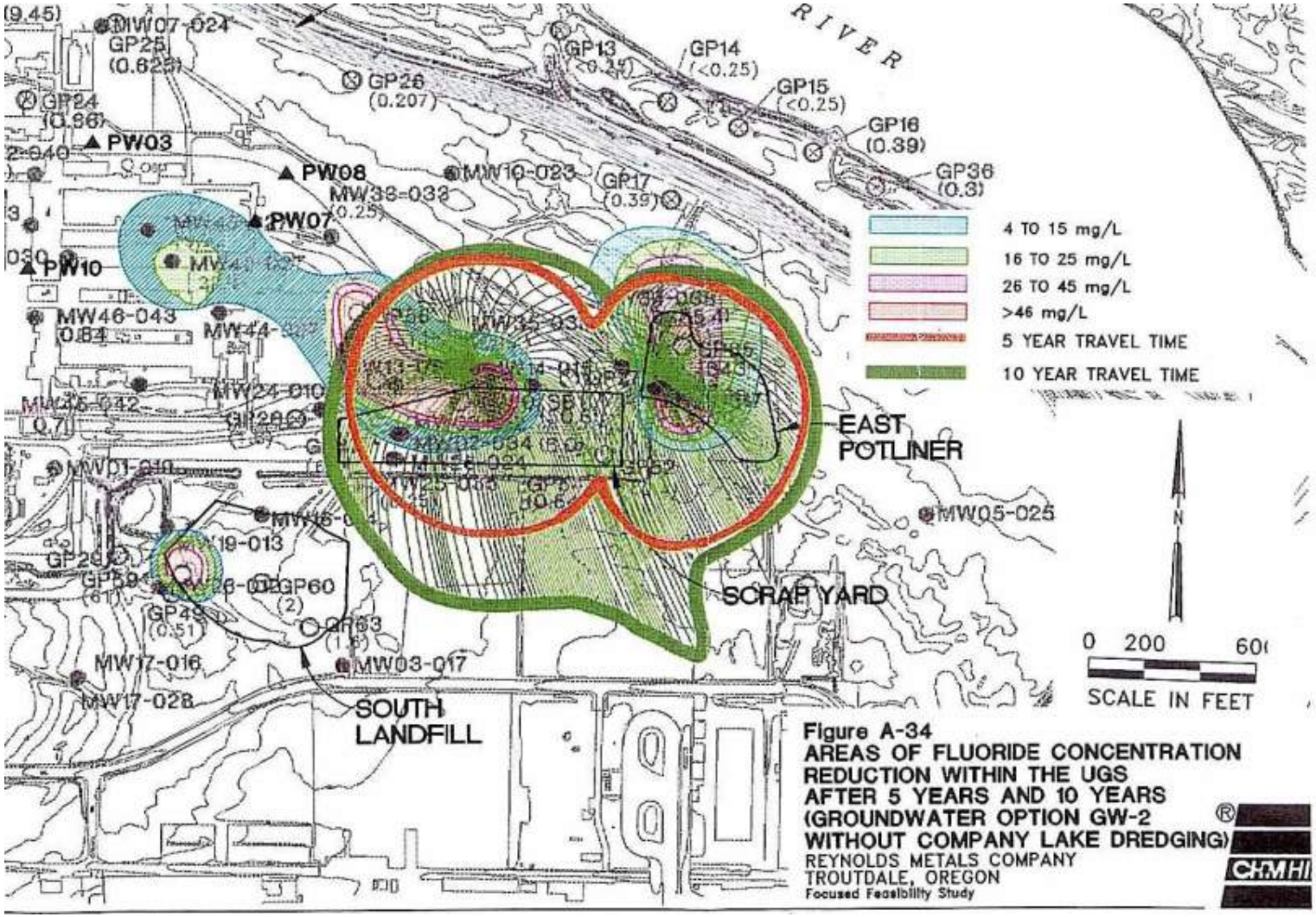
**2 Hours FE02 Recovery**
**Straight Line Distance Drawdown Plot**
**Focused Extraction Startup Testing**

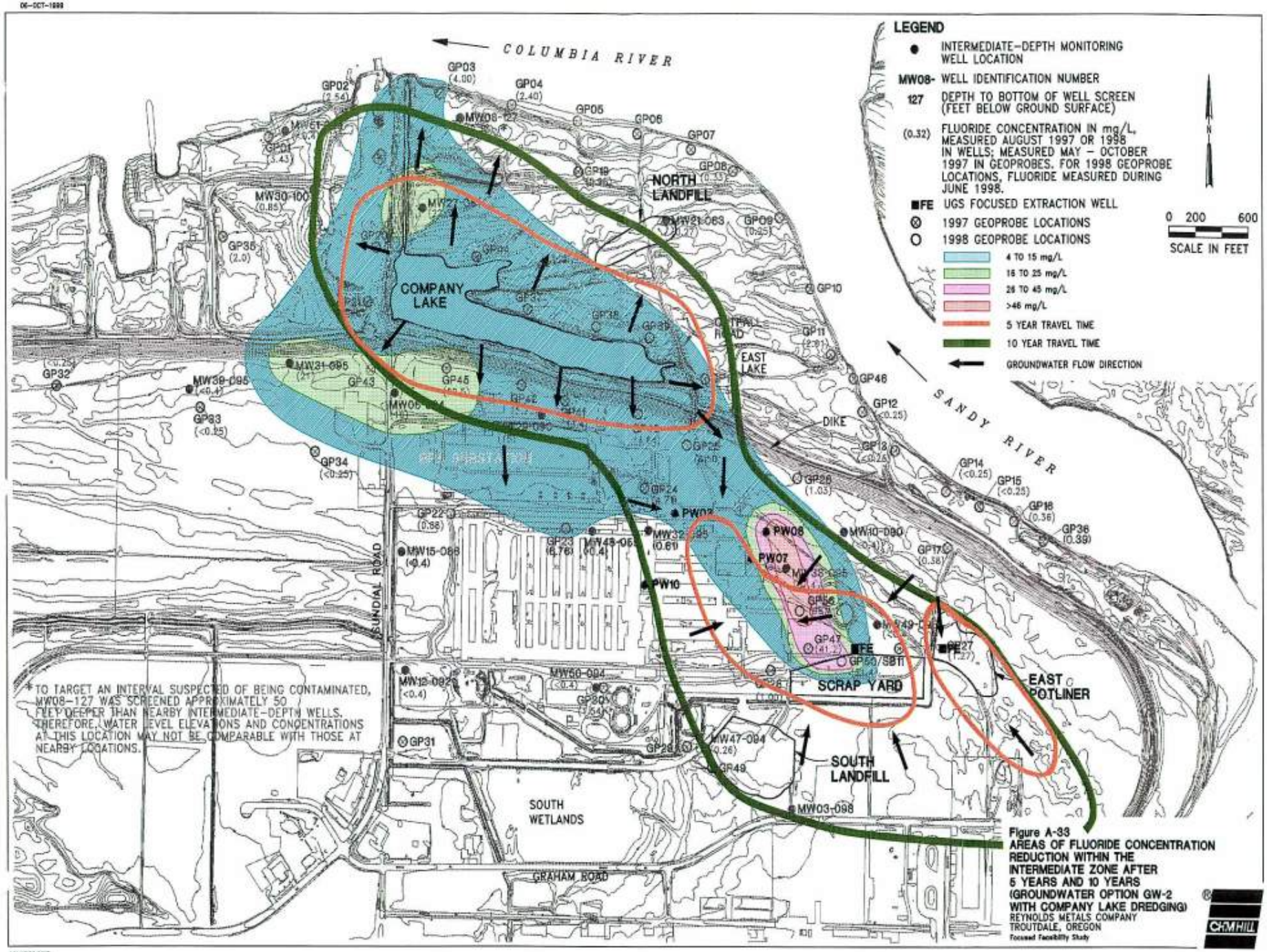


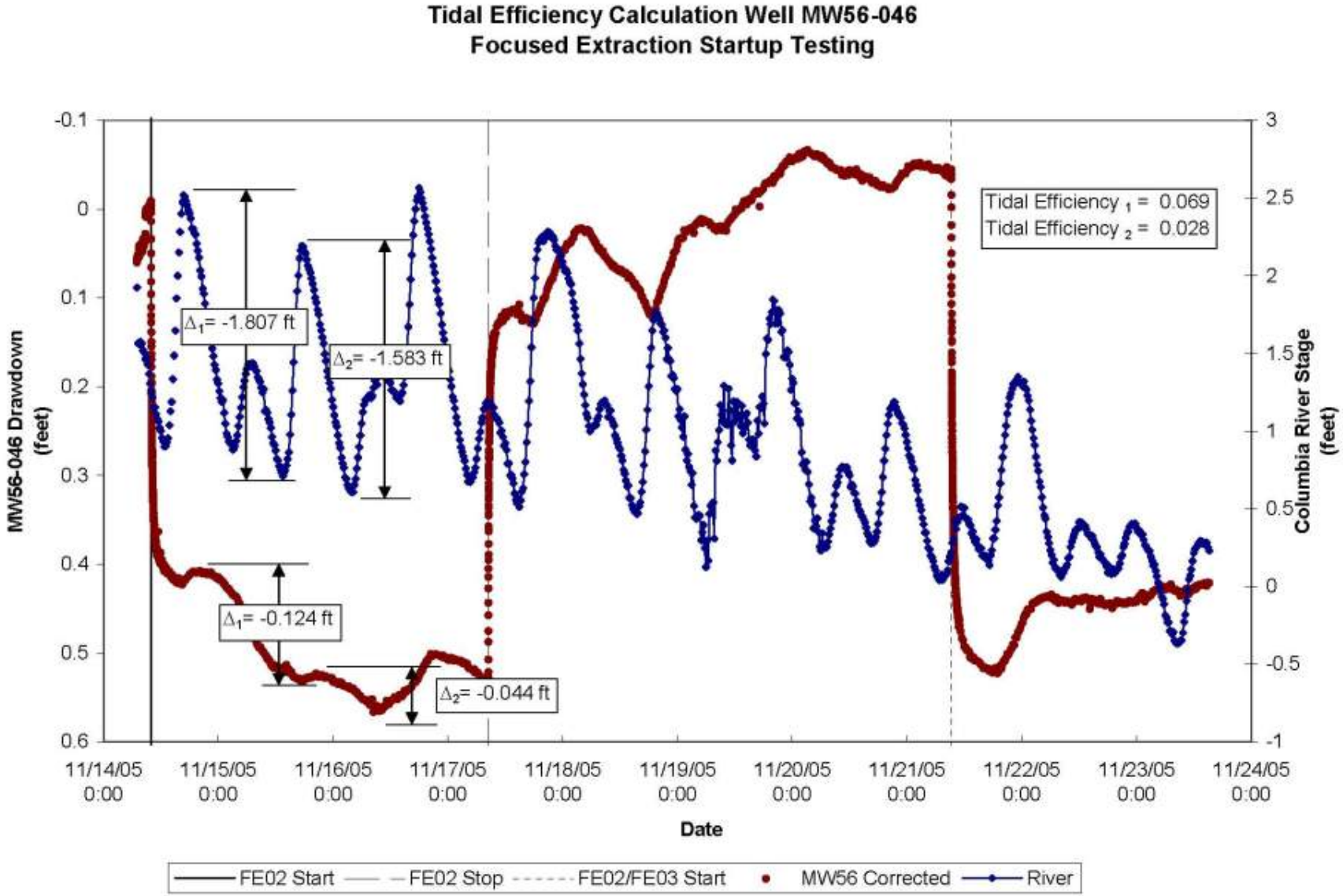
**4 Hours FE02 / FE03 Drawdown**
**Straight Line Distance Drawdown Plot**
**Focused Extraction Startup Testing**

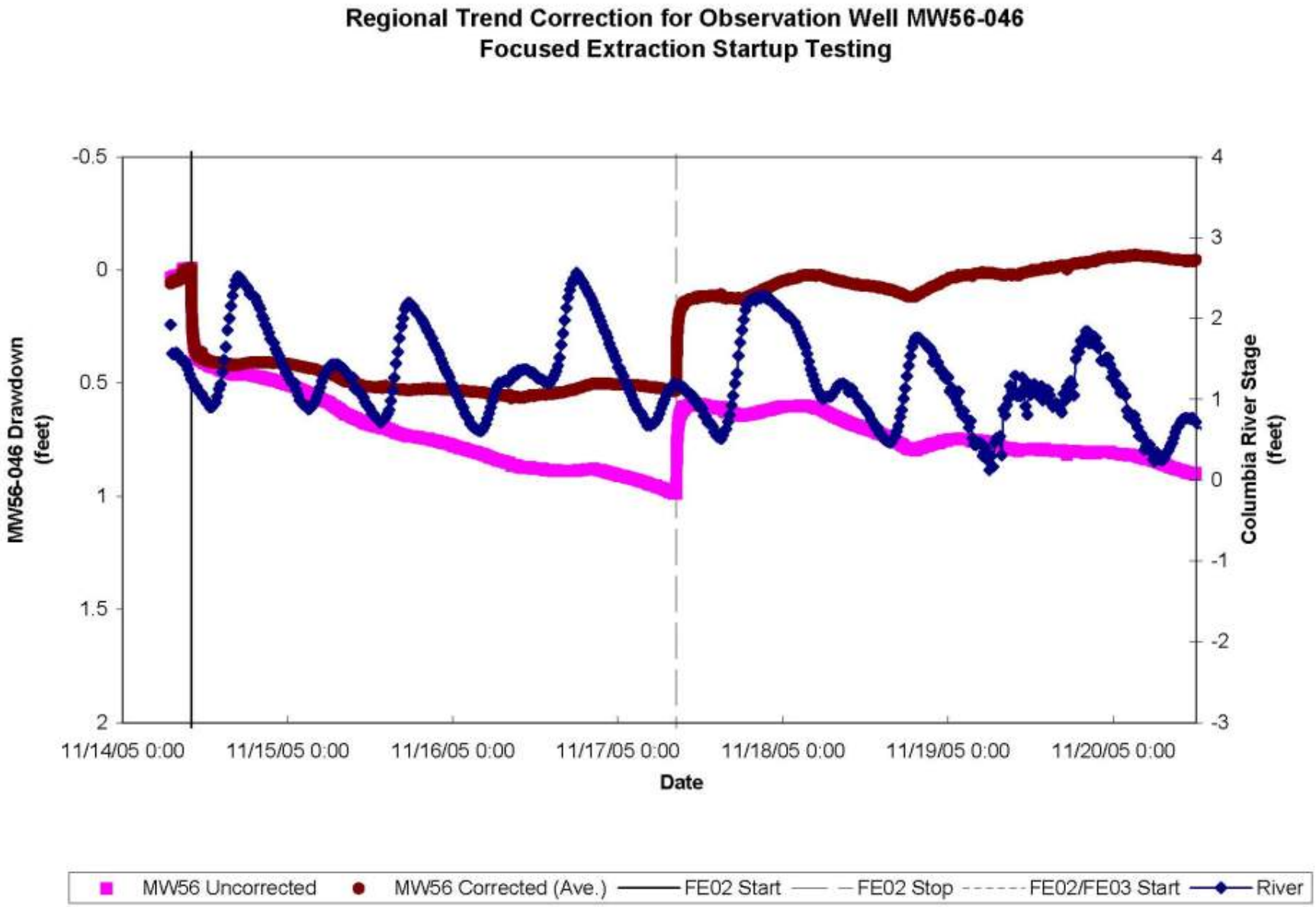


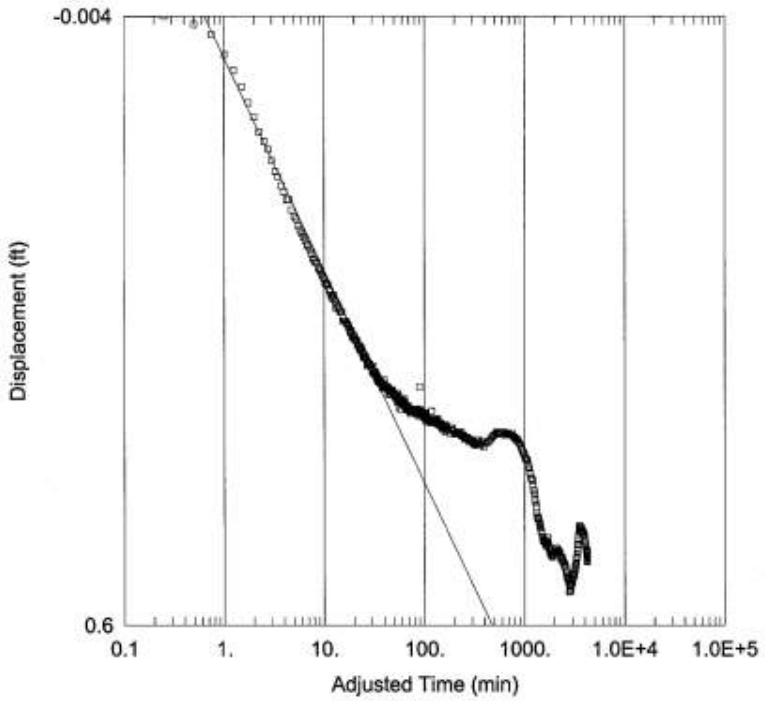
# MICROFEM OUTPUT – FFS




06-OCT-1998
COLUMBIA RIVER
SANDY RIVER
LEGEND
INTERMEDIATE-DEPTH MONITORING WELL LOCATION
MW08- WELL IDENTIFICATION NUMBER
127 DEPTH TO BOTTOM OF WELL SCREEN (FEET BELOW GROUND SURFACE)
(0.32) FLUORIDE CONCENTRATION IN mg/L, MEASURED AUGUST 1997 OR 1998 IN WELLS; MEASURED MAY – OCTOBER 1997 IN GEOPROBES. FOR 1998 GEOPROBE LOCATIONS, FLUORIDE MEASURED DURING JUNE 1998.
FE UGS FOCUSED EXTRACTION WELL
1997 GEOPROBE LOCATIONS
1998 GEOPROBE LOCATIONS
4 TO 15 mg/L
15 TO 25 mg/L
25 TO 45 mg/L
>45 mg/L
5 YEAR TRAVEL TIME
10 YEAR TRAVEL TIME
GROUNDWATER FLOW DIRECTION
0 200 600
SCALE IN FEET
N
NORTH LANDFILL
COMPANY LAKE
EAST LAKE
OUTFALL ROAD
DIKE
SUNDIAL ROAD
SCRAP YARD
EAST POTLINER
SOUTH LANDFILL
SOUTH WETLANDS
GRAHAM ROAD
PW07
PW08
PW10
* TO TARGET AN INTERVAL SUSPECTED OF BEING CONTAMINATED, MW08-127 WAS SCREENED APPROXIMATELY 50 FEET DEEPER THAN NEARBY INTERMEDIATE-DEPTH WELLS. THEREFORE, WATER LEVEL ELEVATIONS AND CONCENTRATIONS AT THIS LOCATION MAY NOT BE COMPARABLE WITH THOSE AT NEARBY LOCATIONS.
Figure A-33
AREAS OF FLUORIDE CONCENTRATION REDUCTION WITHIN THE INTERMEDIATE ZONE AFTER 5 YEARS AND 10 YEARS (GROUNDWATER OPTION GW-2 WITH COMPANY LAKE DREDGING)
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Focused Feasibility Study
CH2MHILL
COLOR55.DWG


Tidal Efficiency Calculation Well MW56-046
Focused Extraction Startup Testing
MW56-046 Drawdown (feet)
Columbia River Stage (feet)
Date
Tidal Efficiency 1 = 0.069
Tidal Efficiency 2 = 0.028
Δ1= -1.807 ft
Δ2= -1.583 ft
Δ1= -0.124 ft
Δ2= -0.044 ft
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
3
2.5
2
1.5
1
0.5
0
-0.5
-1
11/14/05 0:00
11/15/05 0:00
11/16/05 0:00
11/17/05 0:00
11/18/05 0:00
11/19/05 0:00
11/20/05 0:00
11/21/05 0:00
11/22/05 0:00
11/23/05 0:00
11/24/05 0:00
FE02 Start
FE02 Stop
FE02/FE03 Start
MW56 Corrected
River


Regional Trend Correction for Observation Well MW56-046
Focused Extraction Startup Testing
MW56-046 Drawdown (feet)
-0.5
0
0.5
1
1.5
2
Columbia River Stage (feet)
4
3
2
1
0
-1
-2
-3
11/14/05 0:00
11/15/05 0:00
11/16/05 0:00
11/17/05 0:00
11/18/05 0:00
11/19/05 0:00
11/20/05 0:00
Date
MW56 Uncorrected
MW56 Corrected (Ave.)
FE02 Start
FE02 Stop
FE02/FE03 Start
River




**Focused Extraction Start Up**

Data Set: P:\...\FE_mw56_dd_earlytime.aqt
Date: 05/23/06 Time: 18:17:24

PROJECT INFORMATION

Company: CH2M HILL
Client: RMC-Alcoa
Location: Troutdale, OR
Test Well: FE02-046
Test Date: November 14 ,2005

AQUIFER DATA

Saturated Thickness: 50. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

| Well Name | X (ft) | Y (ft) |
|---|---|---|
| FE02-046 | 0 | 0 |

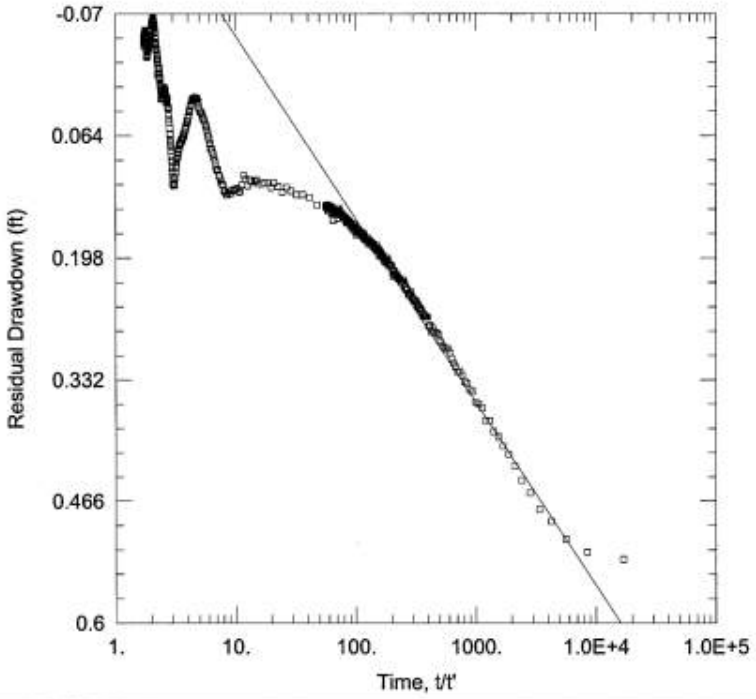
Observation Wells

| Well Name | X (ft) | Y (ft) |
|---|---|---|
| MW56-046 | 0 | 75 |

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 4612.6 $ft^2$/day S = 0.0008471




**Focused Extraction Start Up**

Data Set: C:\Documents and Settings\dlacey\Desktop\RMC\FE_mw56_recovery.aqt
Date: 05/23/06 Time: 18:50:18

PROJECT INFORMATION

Company: CH2M HILL
Client: RMC-Alcoa
Location: Troutdale, OR
Test Well: FE02-046
Test Date: November 14 ,2005

AQUIFER DATA

Saturated Thickness: 50. ft Anisotropy Ratio (Kz/Kr): 1.

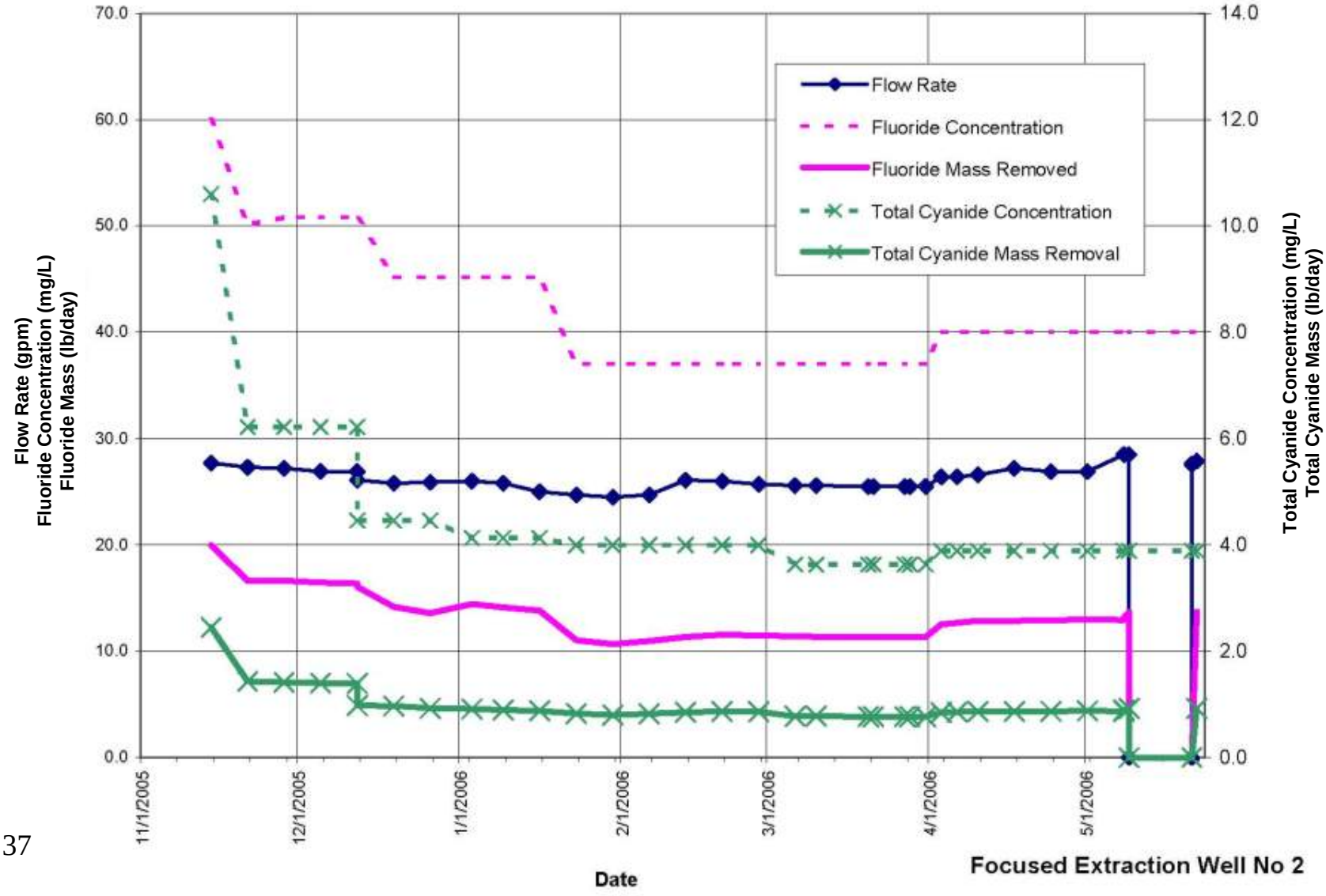
WELL DATA

| Pumping Wells | | | Observation Wells | | |
|---|---|---|---|---|---|
| Well Name | X (ft) | Y (ft) | Well Name | X (ft) | Y (ft) |
| FE02-046 | 0 | 0 | ▫ MW56-046 | 0 | 75 |

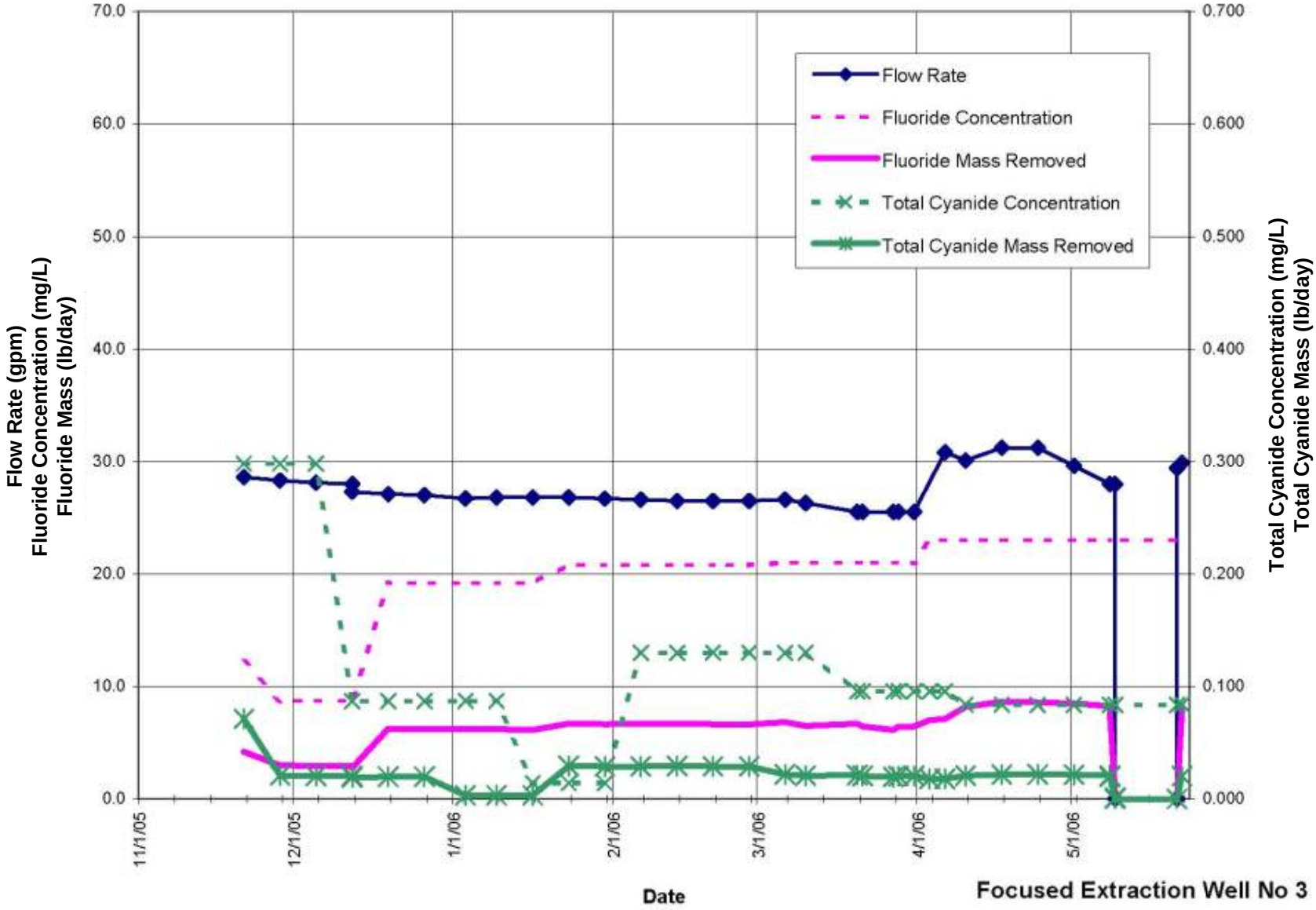
SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)
T = 4815.9 $ft^2$/day S/S' = 16.91

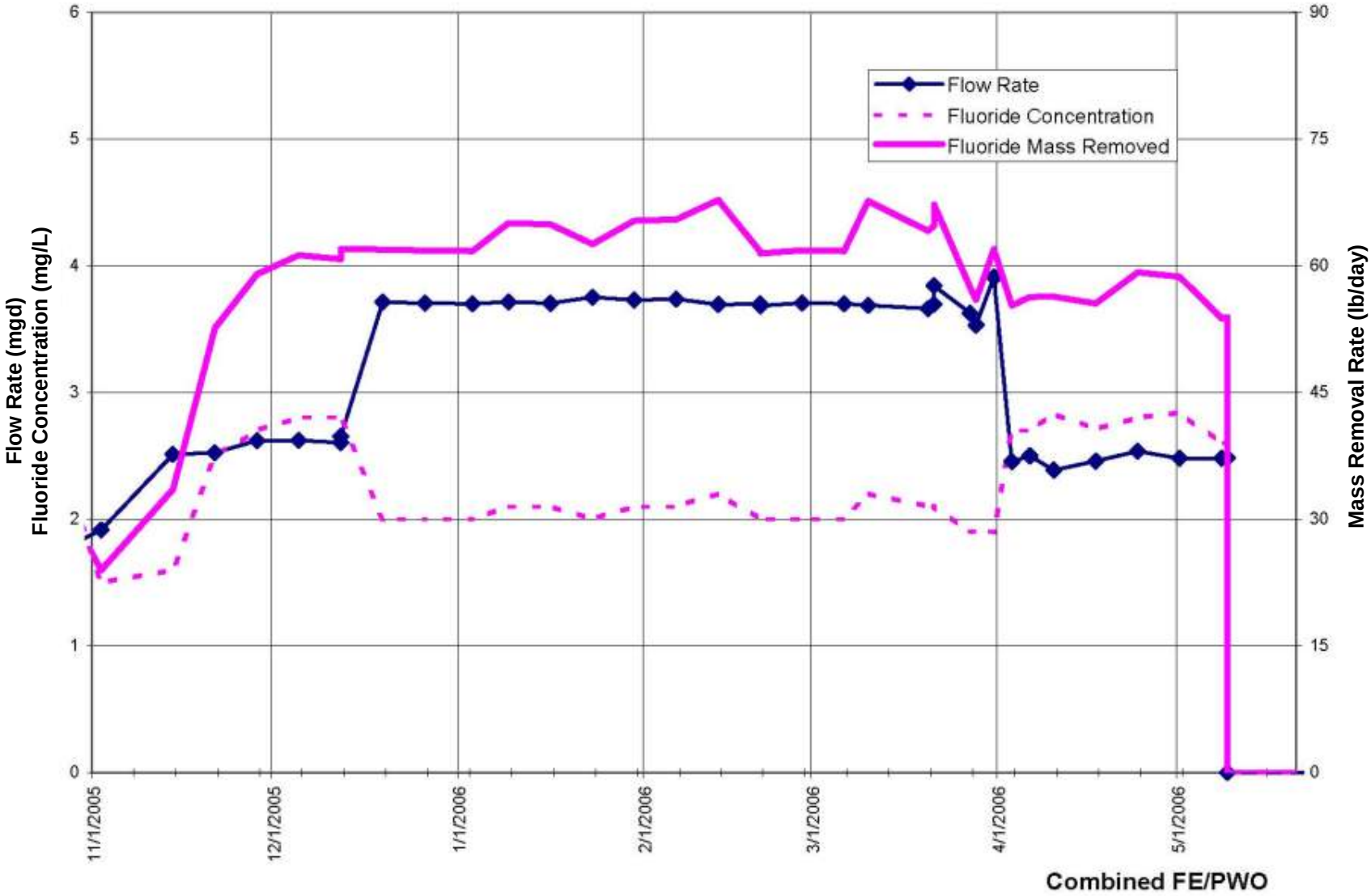
# FE02 – WATER QUALITY



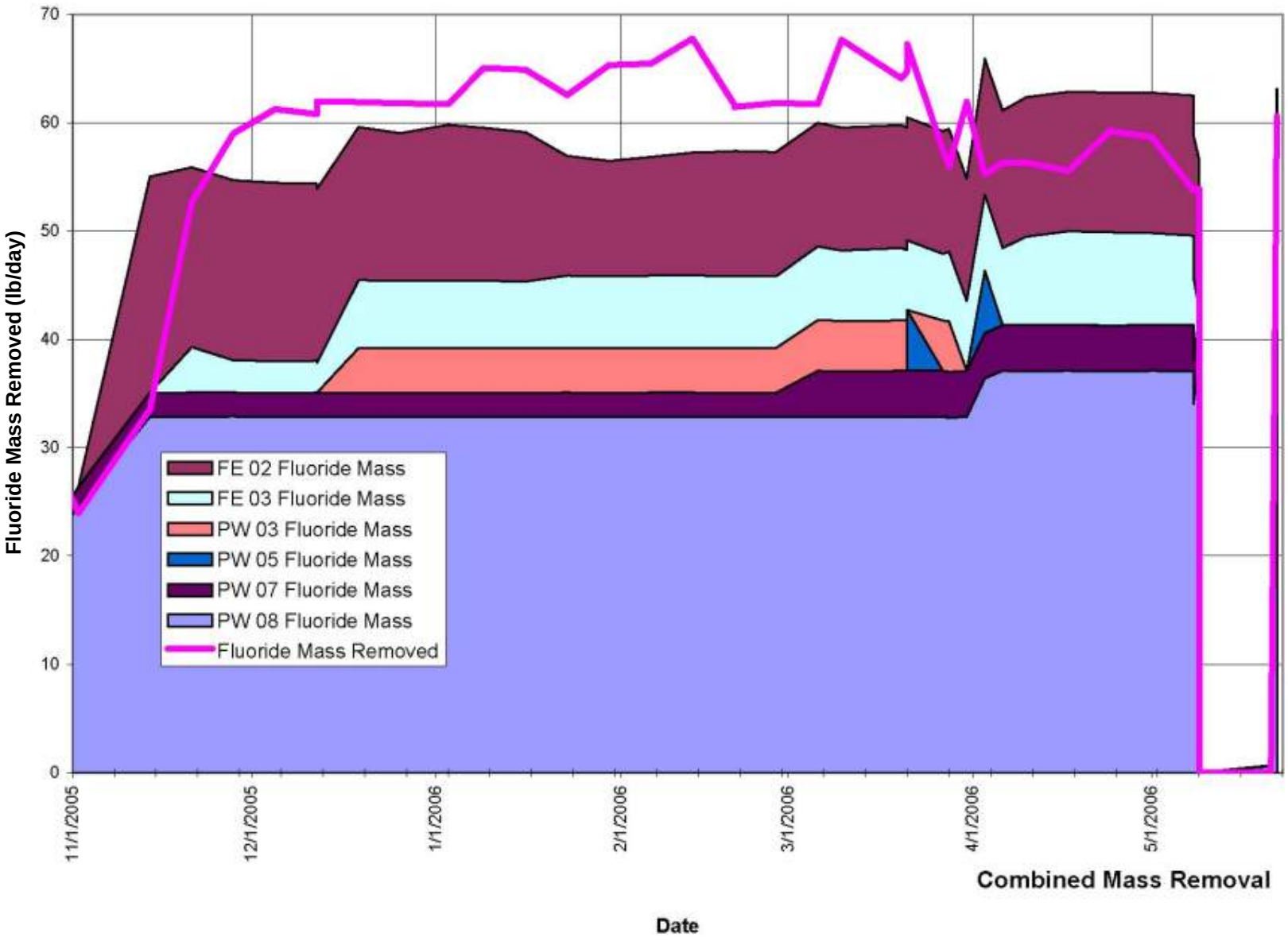
# FE03 – WATER QUALITY



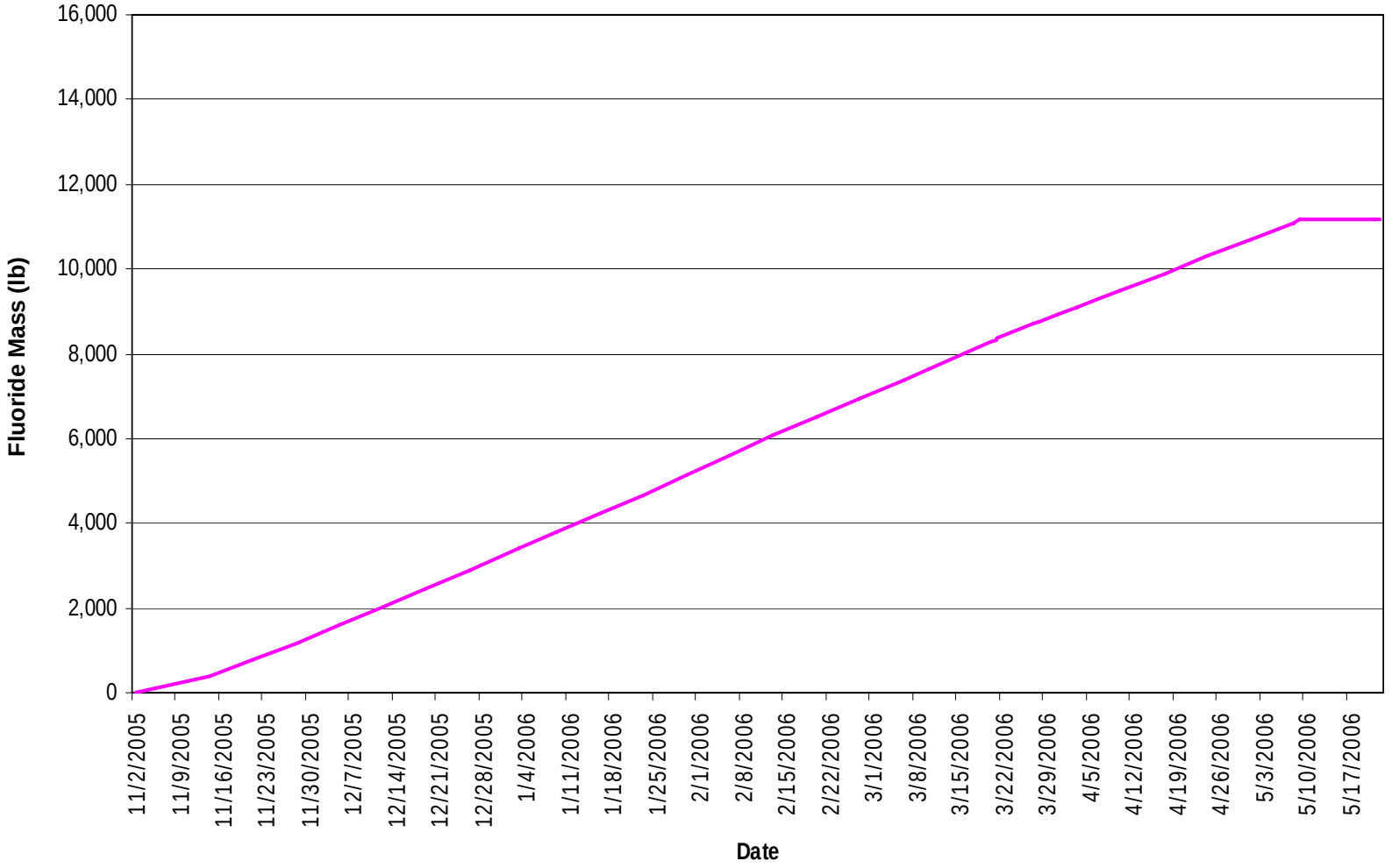
# COMBINED WATER QUALITY



# Combined Total Mass Removed (lb/day)

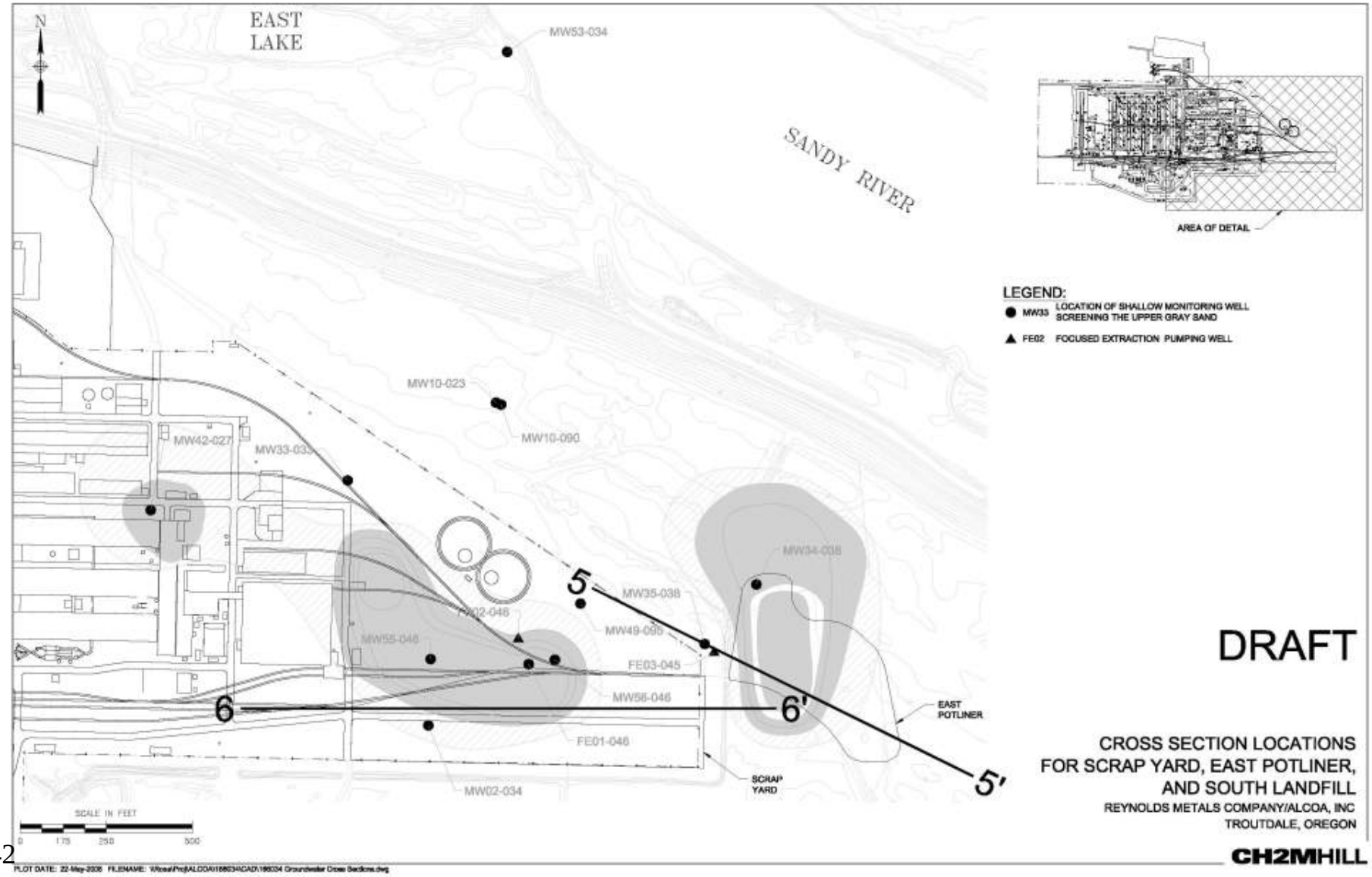


# Combined Cumulative Mass Removed (lb)

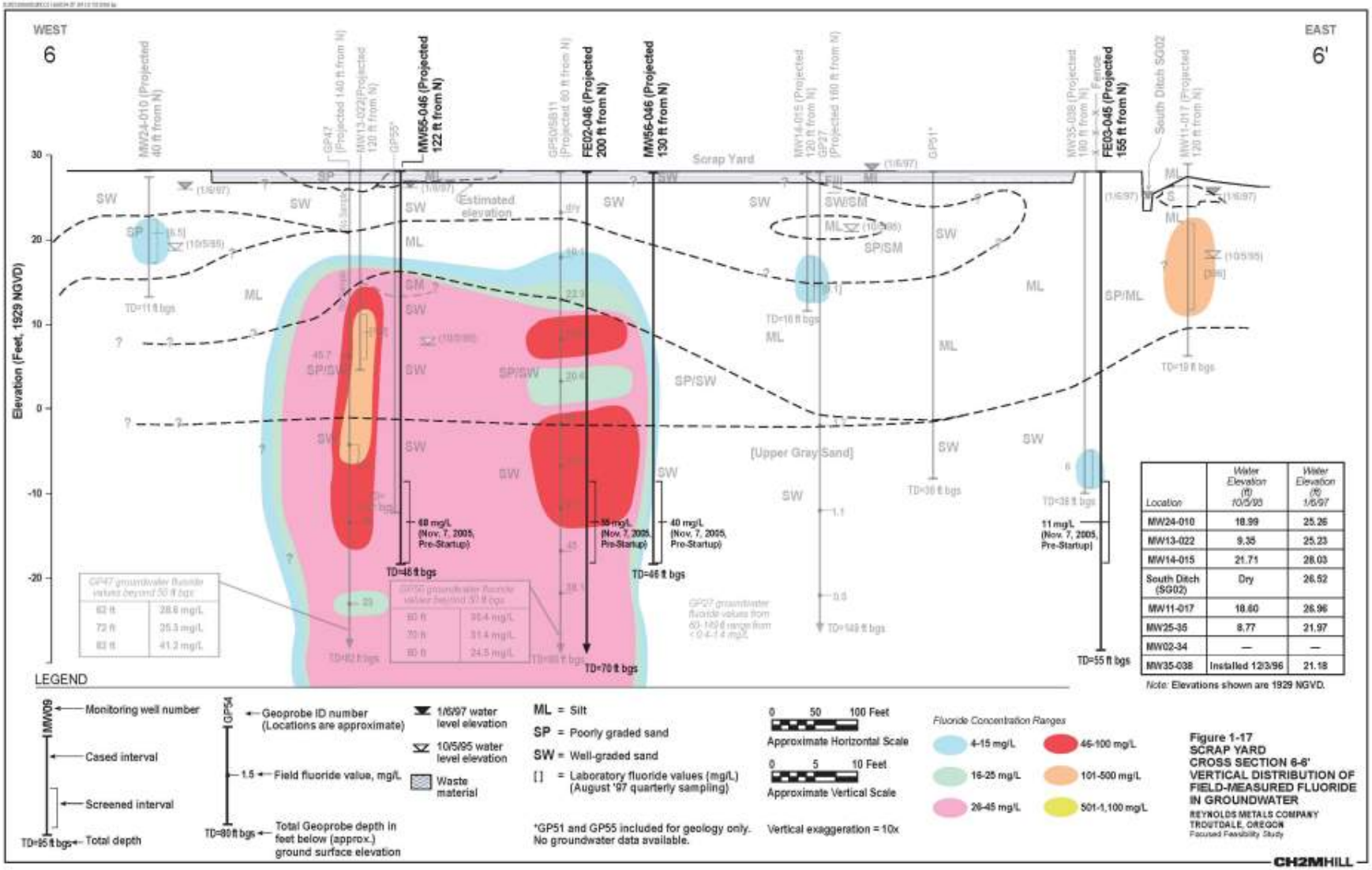



Fluoride Cumulative Mass Removed (lbs)

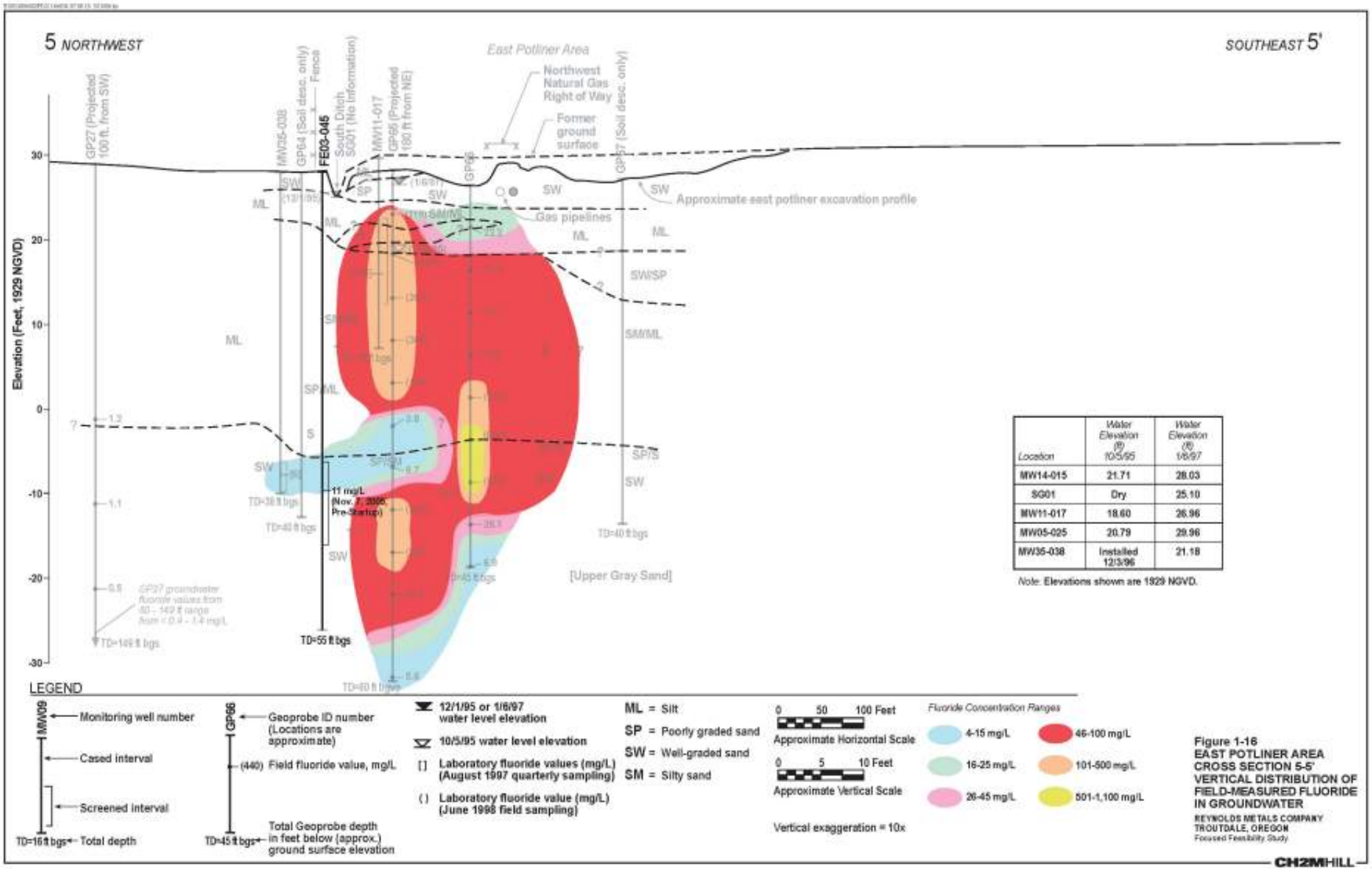
# Cross Section - South Plant



# Cross Section 6-6' - Scrap Yard


WEST
6
EAST
6'
Elevation (Feet, 1929 NGVD)
Scrap Yard
Estimated elevation
[Upper Gray Sand]
MW24-010 (Projected 40 ft from N)
MW55-046 (Projected 122 ft from N)
FE02-046 (Projected 200 ft from N)
MW56-046 (Projected 130 ft from N)
FE03-045 (Projected 155 ft from N)
South Ditch SG02
68 mg/L (Nov. 7, 2005, Pre-Startup)
55 mg/L (Nov. 7, 2005, Pre-Startup)
40 mg/L (Nov. 7, 2005, Pre-Startup)
11 mg/L (Nov. 7, 2005, Pre-Startup)
TD=46 ft bgs
TD=70 ft bgs
TD=55 ft bgs
LEGEND
Monitoring well number
Cased interval
Screened interval
Total depth
Geoprobe ID number (Locations are approximate)
Field fluoride value, mg/L
Total Geoprobe depth in feet below (approx.) ground surface elevation
1/6/97 water level elevation
10/5/95 water level elevation
Waste material
ML = Silt
SP = Poorly graded sand
SW = Well-graded sand
[ ] = Laboratory fluoride values (mg/L) (August '97 quarterly sampling)
*GP51 and GP55 included for geology only. No groundwater data available.
Approximate Horizontal Scale
Approximate Vertical Scale
Vertical exaggeration = 10x
Fluoride Concentration Ranges
4-15 mg/L
16-25 mg/L
26-45 mg/L
46-100 mg/L
101-500 mg/L
501-1,100 mg/L
Location | Water Elevation (ft) 10/5/95 | Water Elevation (ft) 1/6/97
MW24-010 | 18.99 | 25.26
MW13-022 | 9.35 | 25.23
MW14-015 | 21.71 | 28.03
South Ditch (SG02) | Dry | 26.52
MW11-017 | 18.60 | 26.96
MW25-35 | 8.77 | 21.97
MW02-34 | — | —
MW35-038 | Installed 12/3/96 | 21.18
Note: Elevations shown are 1929 NGVD.
Figure 1-17
SCRAP YARD
CROSS SECTION 6-6'
VERTICAL DISTRIBUTION OF FIELD-MEASURED FLUORIDE IN GROUNDWATER
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Focused Feasibility Study
CH2MHILL

# Cross Section 5-5' - East Potliner Area


5 NORTHWEST
SOUTHEAST 5'
East Potliner Area
Northwest Natural Gas Right of Way
Former ground surface
Approximate east potliner excavation profile
Gas pipelines
Elevation (Feet, 1929 NGVD)
[Upper Gray Sand]
TD=55 ft bgs
11 mg/L (Nov. 7, 2006 Pre-Startup)
GP27 groundwater fluoride values from 80 - 149 ft range from < 0.4 - 1.4 mg/L
LEGEND
Monitoring well number
Cased interval
Screened interval
Total depth
Geoprobe ID number (Locations are approximate)
(440) Field fluoride value, mg/L
Total Geoprobe depth in feet below (approx.) ground surface elevation
12/1/95 or 1/6/97 water level elevation
10/5/95 water level elevation
[] Laboratory fluoride values (mg/L) (August 1997 quarterly sampling)
() Laboratory fluoride value (mg/L) (June 1998 field sampling)
ML = Silt
SP = Poorly graded sand
SW = Well-graded sand
SM = Silty sand
Approximate Horizontal Scale
Approximate Vertical Scale
Vertical exaggeration = 10x
Fluoride Concentration Ranges
4-15 mg/L
16-25 mg/L
26-45 mg/L
46-100 mg/L
101-500 mg/L
501-1,100 mg/L

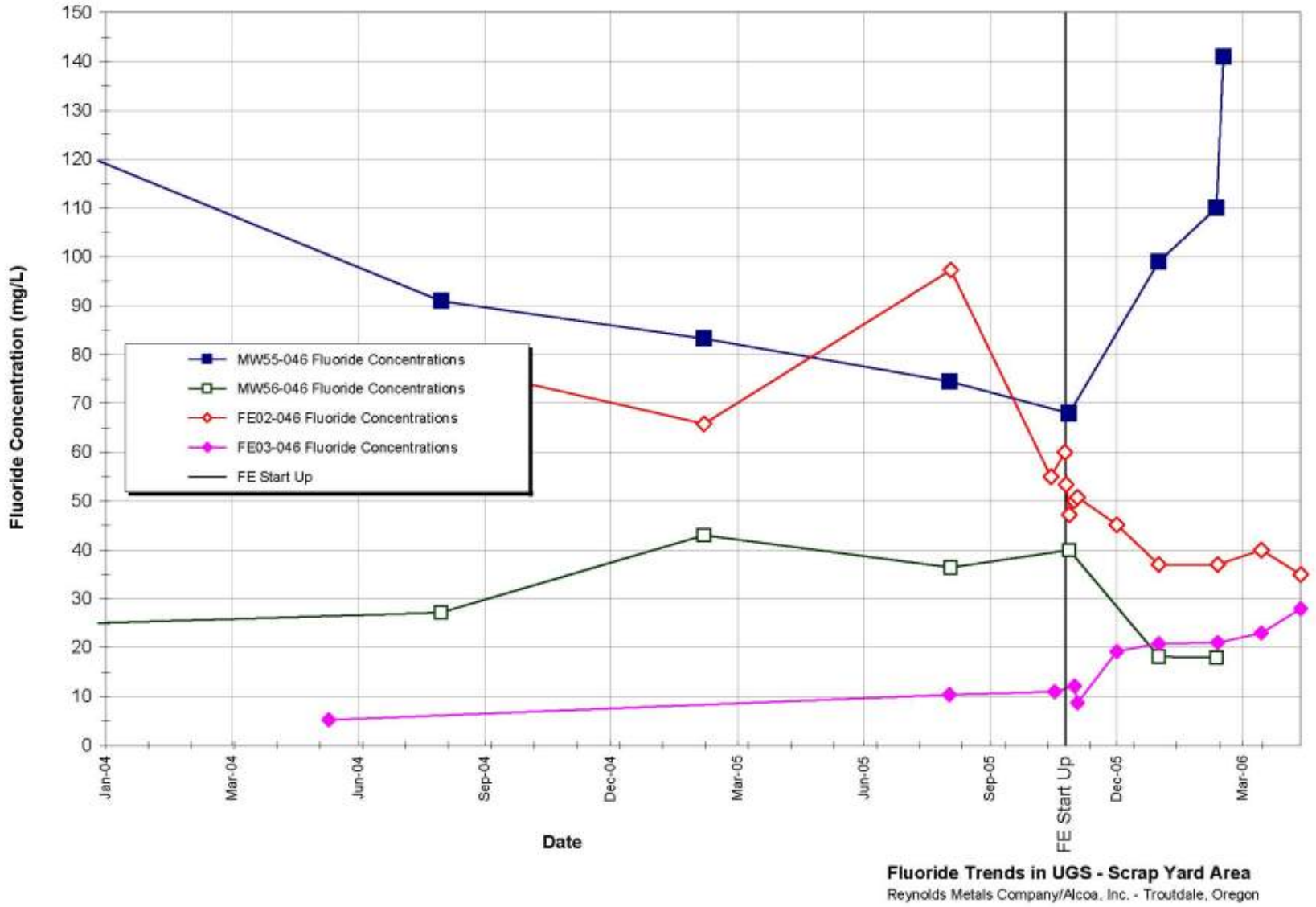
| Location | Water Elevation (ft) 10/5/95 | Water Elevation (ft) 1/6/97 |
|---|---|---|
| MW14-015 | 21.71 | 28.03 |
| SG01 | Dry | 25.10 |
| MW11-017 | 18.60 | 26.96 |
| MW05-025 | 20.79 | 29.96 |
| MW35-038 | Installed 12/3/96 | 21.18 |

Note: Elevations shown are 1929 NGVD.

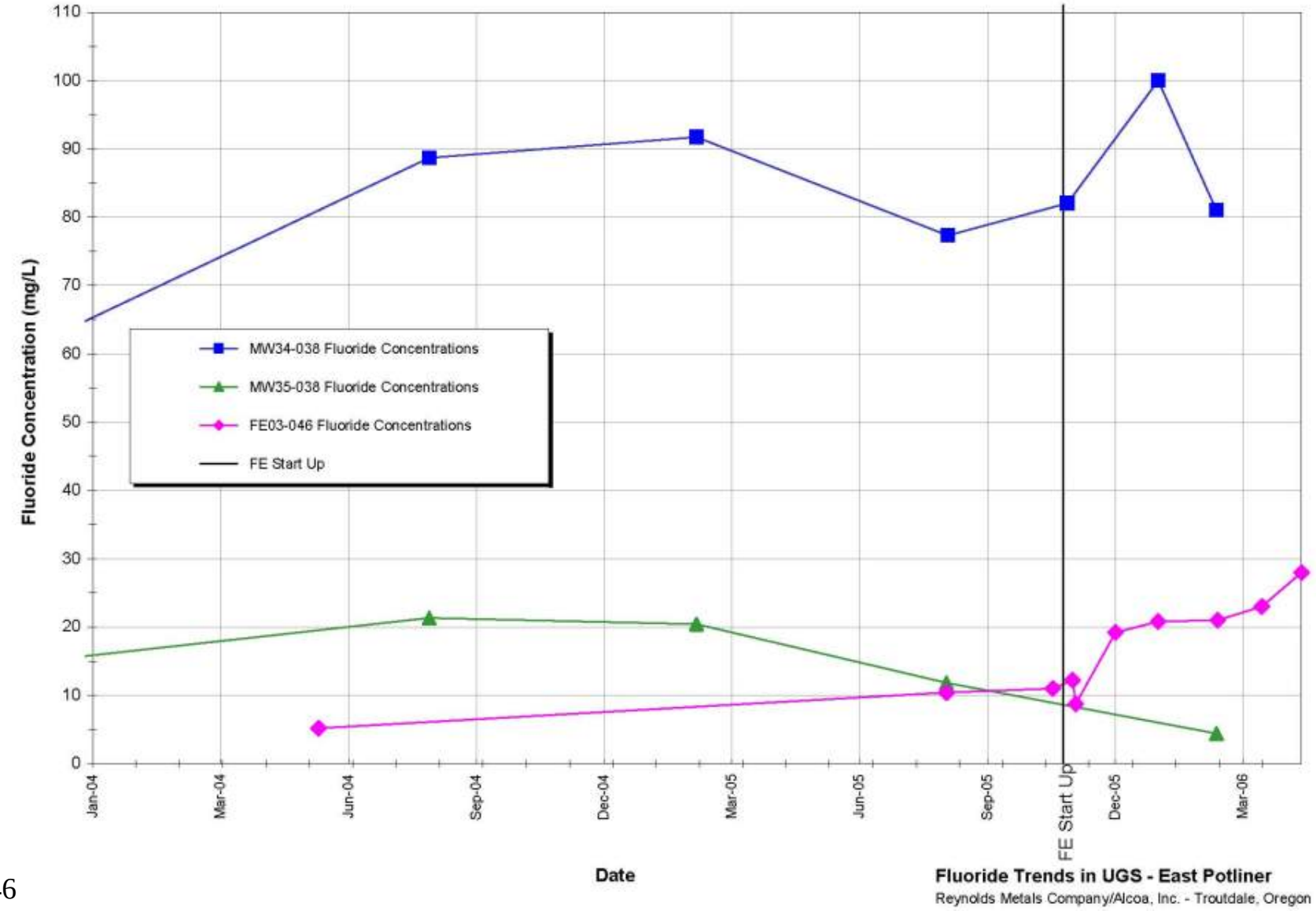
Figure 1-16
EAST POTLINER AREA
CROSS SECTION 5-5'
VERTICAL DISTRIBUTION OF FIELD-MEASURED FLUORIDE IN GROUNDWATER
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
Focused Feasibility Study

CH2MHILL

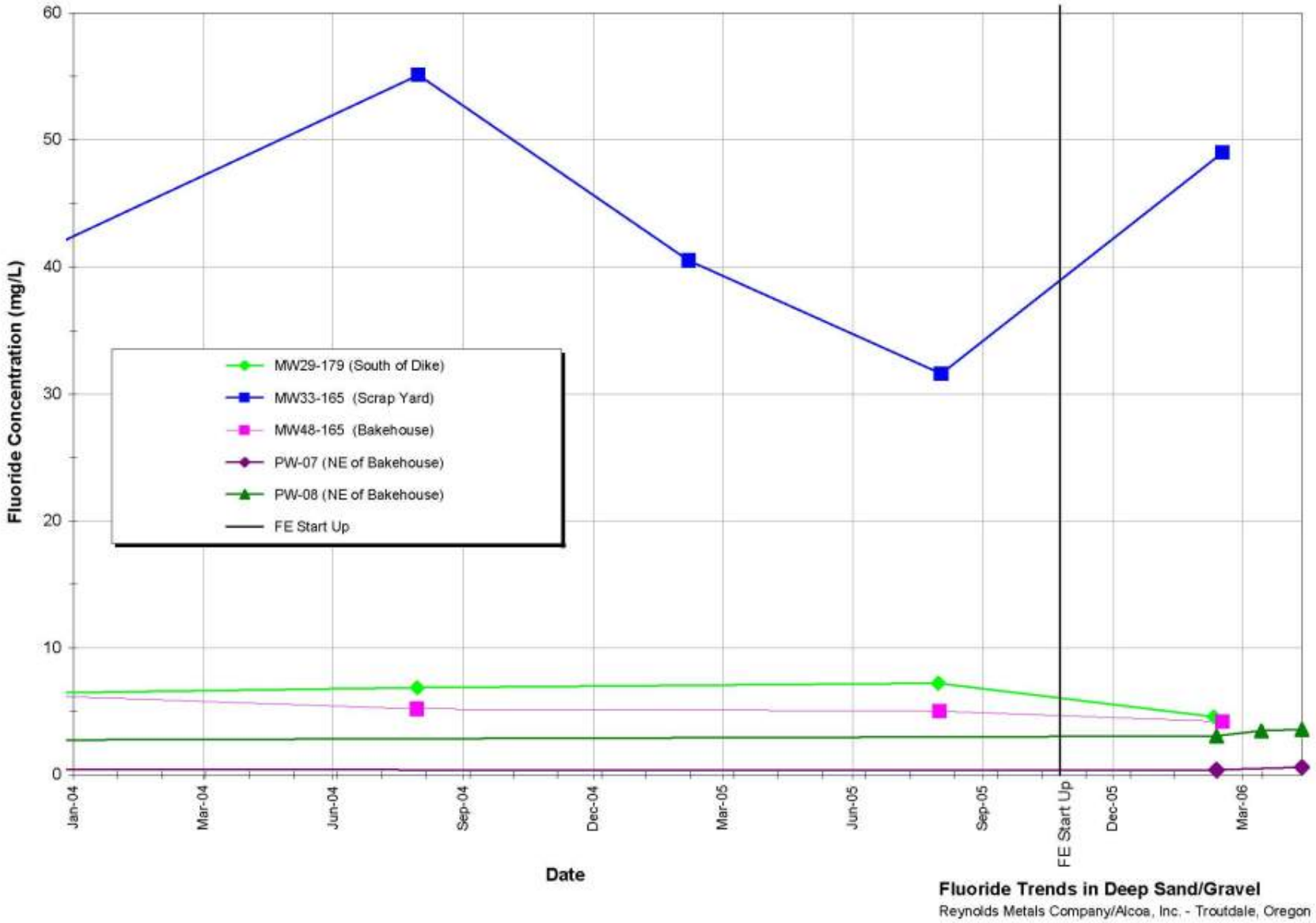
# Fluoride Trends in UGS – Scrap Yard



# Fluoride Trends in UGS – East Potliner



# Fluoride Trends in Deep Sand/Gravel



# Summary

- **Establish operation pumping rates at FE02-046 and FE03-045**
  - FE-02 at approximately 27 gpm.
  - FE-03 at approximately 25 gpm.
  - Current rates meet or exceed Interim ROD requirement.
  - Continue to monitor.
- **Determine the area of influence of the focused extraction system**

Use multiple lines of evidence for capture:

- Contour maps demonstrate good capture.
- Distance Drawdown plots show that pumping influences extend to edge of plumes.
- Observed performance matches model results (results validate a model that shows capture).
- Concentration trends indicate capture (mass is being removed!).

These lines of evidence demonstrate system performance consistent with model results and Interim ROD

# Summary (Continued)

- **Determine fluoride and cyanide concentration trends during the focused extraction system startup**
  - FE-02: fluoride initially decreased, now constant at 40 mg/L. Cyanide (same trend), now constant at 4 mg/L.
  - FE-03: fluoride slightly increasing, now at approx. 20 mg/L. Cyanide constant at 0.10 mg/L.
- **Determine whether additional focused extraction wells are required to establish hydraulic control over the area where fluoride concentrations exceed the limits established in the Record of Decision (ROD)**
  - No additional extraction wells needed to meet RAOs.

# Summary (Continued)

- **Determine whether additional piezometers are required to assess system performance**
  - One additional monitoring well in the East Potliner area.
- **The FE system performance is meeting the Interim ROD RAOs**
- **FE system meeting intent to remove mass**

**APPENDIX C**

# *Operation, Inspection, and Maintenance Manual—Focused Extraction/Production Well Optimization System, RMC-Troutdale Facility* (CH2M HILL, October 2006)

# Operation, Inspection, and Maintenance Manual - Focused Extraction/Production Well Optimization System, RMC-Troutdale Facility

**Reynolds Metals Company**
**TROUTDALE FACILITY**

**CH2MHILL**

October 2006

**Printed on Recycled and Recyclable Paper**

# 1.0 Introduction

The Reynolds Metals Company (RMC) Troutdale facility is the site of a former aluminum reduction plant that ceased operations in the fall of 2000 and was subsequently demolished from 2003 through January 2006. Based on soil and groundwater contamination from past plant operations in the east potliner and scrap yard area a Focused Extraction and Production Well Optimization (FE/PWO) system was installed to provide hydraulic containment and removal of groundwater containing high levels of fluoride. Final construction of the FE/PWO system was completed in October 2005 and continuous operation of the FE/PWO system began on November 21, 2005. This manual describes the system configuration and outlines procedures to operate, inspect, and maintain the FE/PWO system. Individual system component operation, inspection and maintenance procedures can be found in the manufacturer' literature. This manual includes a schedule for the inspection and maintenance of the FE/PWO system and individual system components.

# 2.0 Objectives

Project specific objectives for the FE/PWO system include:

- Flow and drawdown from the focused extraction (FE) wells sufficient to capture and remove groundwater with high levels of fluoride in the Upper Gray Sand (UGS) zone in the vicinity of the scrap yard and east potliner sites.
- Flow and drawdown from the production (PW) wells sufficient to provide hydraulic containment of fluoride plumes in the south plant area.
- Combined FE/PWO discharge to the Columbia River that meet existing plant National Pollutant Discharge Elimination System (NPDES) permit levels.
- Combined FE/PWO discharge to the Columbia River that does not exceed 5 mg/l for fluoride.
- Operation and maintenance of the system for a minimum of 5 years.

This plan is organized into the following sections:

1.0 Introduction
2.0 Objectives
3.0 System Overview and Operation
4.0 Operation Procedures
5.0 Inspection Procedures
6.0 Maintenance Procedures
7.0 Recordkeeping

Appendix A – As-built Drawings and Diagrams
Appendix B – Operation Procedures
Appendix C – Inspection Procedures
Appendix D – Maintenance Procedures
Appendix E – Operation, Inspection, and Maintenance Logs and Schedules - Forms
Appendix F – Operation Log - Data
Appendix G – Maintenance Log – Data

# 3.0 System Overview and Operation

The FE/PWO system is designed to provide hydraulic containment of fluoride plumes in the south plant area and to capture and remove high fluoride concentration groundwater in the vicinity of the scrap yard and east potliner areas. During system operation, groundwater is removed through a combination of shallow focused extraction wells (FE02 and FE03) and a minimum of two of four deep production wells (PW03, PW05, PW07, and PW08). Groundwater removed by the operating focused extraction and production well is blended and discharged to the Columbia River. Figure 1 illustrates the locations of the focused extraction, production, and monitoring wells; piping sizes; and general system layout. Detailed system design information including pipe size, and valve, meter, and gauge locations are illustrated in the as-built drawings included in Appendix A.

### System Flow Layout

In general, groundwater from the focused extraction wells flows through a 4-inch diameter underground pipe to Building 70 and blends with groundwater from the production wells. Groundwater from the production wells is transported to Building 70 via 8-inch and 10-inch diameter underground pipes. After blending, the combined flow from the FE/PWO system is discharged to a 12-inch diameter underground pipe that connects to an existing 16-inch diameter pipe located adjacent to Sundial Road. The 16-inch diameter pipe discharges to the Columbia River under an existing NPDES Permit (Oregon Permit # 100757, EPA Permit # OR-0000060). Figure 2 illustrates the general flow, mixing, and discharge of the extracted groundwater by the FE/PWO system.

### Major Components

The FE/PWO system is comprised of a few major component groups. These major component groups include:

- Focused extraction wells and assemblies
- Production wells and assemblies
- System controls and Motor control center (MCC)
- Discharge line and assemblies
- Sample Basin and Automatic Samplers
- Building 70 and system areas

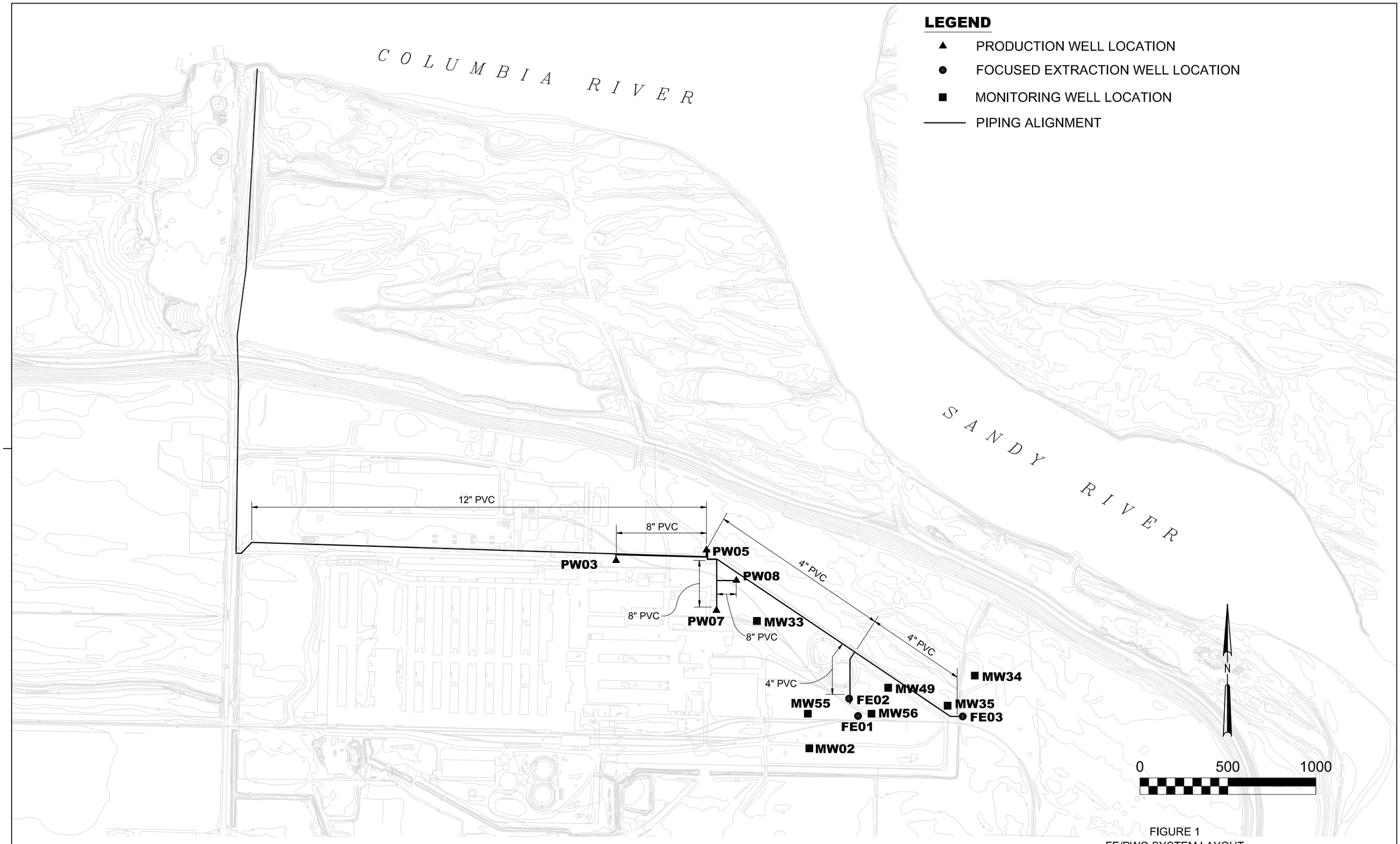



FIGURE 1
FE/PWO SYSTEM LAYOUT

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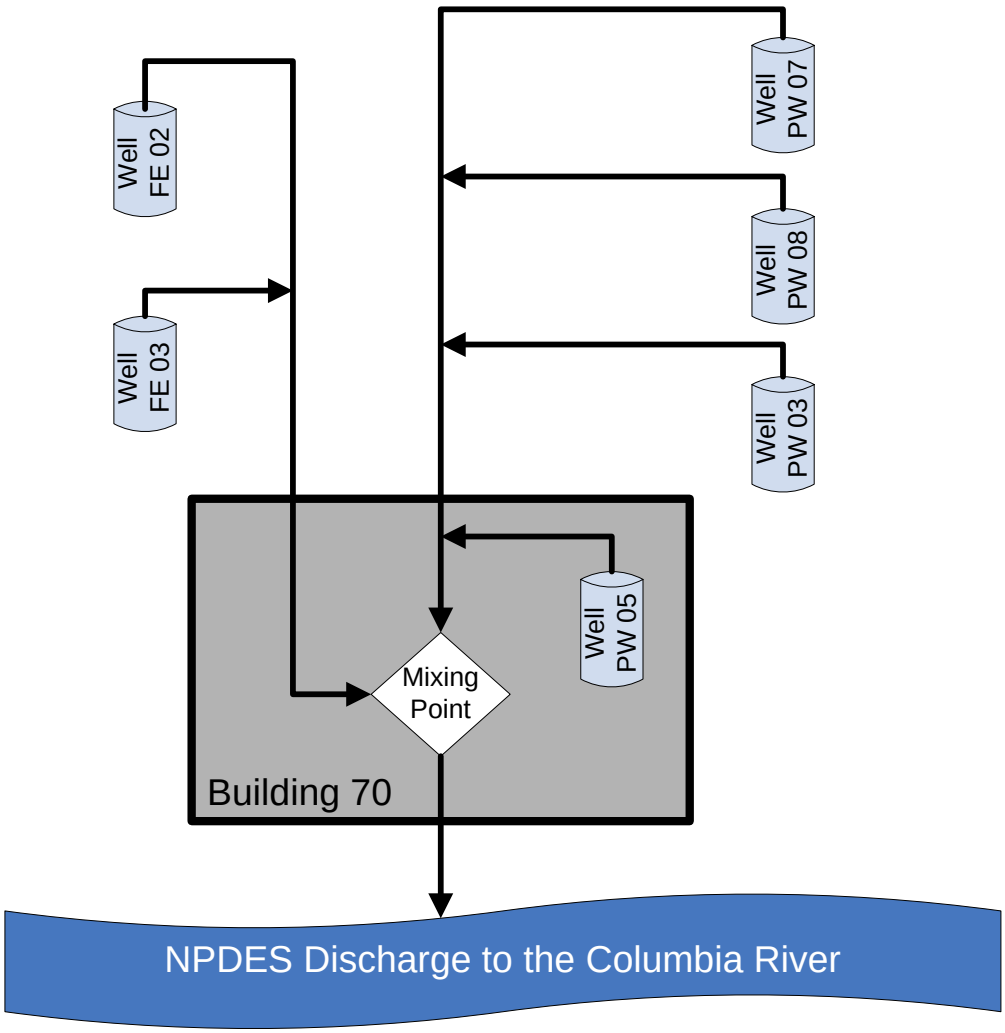


**Figure 2 –** Generalized FE/PWO System Configuration and Operation Diagram

# 4.0 Operation Procedures

The FE/PWO system should be operated such that the capture and containment of the fluoride plume beneath the site is optimized as outlined in the Reynolds Metals Company Superfund Site, Troutdale, Oregon, *Record of Decision for Final Remedial Action* (USEPA, September 29, 2006). To achieve this performance requirement, the system was designed to operate with two PW wells running at approximately 600 gallons per minute (gpm) each in conjunction with two FE wells running at approximately 20 gpm each. The system was planned with PW-07 and PW-08 as the primary production wells and PW-03 and PW-05 available as backup production wells as needed. This arrangement allows continued operation in the event of primary production well shutdown and maintenance or the need for additional pumping capacity to sustain satisfactory performance and discharge requirements. The FE/PWO system includes an interlock safeguard to prevent the FE wells from running if the PW wells are not operational. Operation of the system is expected to continue for a minimum of 5 years. FE/PWO system operation procedures include:

OP-01 – System Startup/Shutdown Procedures
OP-02 – Sample Sink/Sample Discharge Return Pump Procedures
OP-03 – NPDES Sample Collection Procedures
OP-04 – Routine Operating Tasks
OP-05 – Flow Adjustment of FE Wells and Pumps

A detailed description for each operational procedure is included in Appendix B. Procedures for operation of individual system components can be found in the manufacturer' literature.

# 5.0 Inspection Procedures

Regular inspection and monitoring of the FE/PWO system is essential in identifying necessary maintenance and continued system operation throughout 5 year minimum operational; period. FE/PWO system inspection procedures include:

IP-01 – Focused Extraction Wells

A detailed description for the focused extraction wells inspection procedure is included in Appendix C. Procedures for the inspection of individual system components can be found in the manufacturer's literature. A schedule of recommended routine inspections and preventative maintenance required for the FE/PWO system including the individual system components is provided in Appendix E, *FE/PWO Routine Inspection and Preventive Maintenance Schedule/Log.*

# 6.0 Maintenance Procedures

Regular routine maintenance and troubleshooting of the FE/PWO system is essential to ensure system functioning throughout the minimum 5 year operational period. FE/PWO system maintenance procedures include:

MP-01 – System Piping in Building 70, Evacuation/Line Breaking
MP-02 – Focused Extraction Well Pump System, Isolation/Line Breaking
MP-03 – Cleaning Focused Extraction Well Flow Totalizer

A detailed description for each maintenance procedure is included in Appendix D. Procedures for maintenance of the individual system components can be found in the manufacturer' literature. A schedule of recommended routine inspections and preventative maintenance required for the FE/PWO system including the individual system components is provided in Appendix E, *FE/PWO Routine Inspection and Preventive Maintenance Schedule/Log*

# 7.0 Recordkeeping

Recordkeeping is an integral part of operating the FE/PWO system. Good recordkeeping will help identify potential maintenance and repair/replacement needs early and is necessary to problem-solve potential malfunctions or operational problems. Detailed and complete notes must be documented in the operation, inspection and maintenance logs on a regular basis. Recordkeeping of the FE/PWO system involves the following major steps:

1. Record general operating, inspection, and maintenance details including observation date, time, observer, observer affiliation, and other notes on the general condition of the system.
2. Record the detailed operating data required on the *FE/PWO Operation Log* (Appendix F). Also record and report any alarms, observed cleaning needs, housekeeping needs, malfunctions, damaged equipment, non-operational equipment, etc.
3. Record completed routine inspections and preventive maintenance routines on the *FE/PWO Routine Inspection and Preventive Maintenance Schedule/Log* (Appendix E).
4. Record both preventive and breakdown maintenance data including maintenance date, time, actions, methods, parts replaced outcomes, etc. on *FE/PWO System Maintenance Log* (Appendix G), with details in supplemental notes. Retain any manufacturer or contractor correspondence regarding these actions.

# Appendix A – As-built Drawings and Diagrams

Appendix A, As-Built Drawings and Diagrams, is included as Appendix A in the main body of the report (*Focused Extraction/Production Well Optimization System Installation*) and is not repeated again in this appendix due to the large file size.

# Appendix B – Operation Procedures

# FE/PWO System Operation Procedure OP-01

| | |
|---|---|
| Procedure No. | OP-01 |
| Procedure: | System Startup/Shutdown Procedures |
| Min. Frequency | Upon Occurrence |
| Original Date: | June 26, 2006 |
| Revision Date: | None |
| Updates: | None |

OPERATING PARAMETERS:

- The system should be operated such that the capture and containment of the contaminated groundwater plume is maximized.
- The system should be operated such that the discharge limits established for the NPDES permit and the final Record of Decision (ROD) are not exceeded.
- To achieve these performance requirements, the FE/PWO system was designed to operate with two Production Wells (PW) {operating at 600 gpm each} and two Focused Extraction (FE) wells {operating at 20 gpm each} running in conjunction.
- The construction of the production wells in the water-bearing zone consists of perforated pipe without a filter pack in a sandy formation. As such it is recommended that the production wells not be operated at a flow rate higher than their historic operating flow rate so as not to over-stress the formation. The historic high flow rates were limited by system pressures of approximately 45 psi. Therefore do not operate the production wells with less than 45-psi backpressure. (If wear has reduced the capacity of the pump the backpressure may be reduced further in order to keep capacity at a minimum of 600 gpm).
- Currently the production wells are operating with 55-psi backpressure at approximately 800 gpm.
- Production well backpressure can be adjusted by opening or closing the gate valve adjacent to the production well and observing the upstream pressure gauge.
- The FE well construction consists of a filter packed well screen in the targeted water-bearing zone. Aquifer tests indicate the pumps can be run full open.
- The focused extraction wells are capable of operated full open at approximately 27 gpm.
- Operating experience has shown that build up of scale and slime can result in plugged well screens, pumps, and piping resulting in reduced yield/flow.
- The flow from the FE well pumps should be controlled to prevent exposing the top of the well screen.
- Inspection of the water level in the well is covered under Inspection Procedure IP-01:
- Focused extraction well motors are interlocked to the production well motors, such that at least one of the production well motors must be running in order for either of the focused extraction wells to run.
- The system is plumbed to allow use of up to four production wells (PW 3, 5, 7 or 8). The primary production wells are PW 7 and PW 8, with PW 3 and PW 5 available as backup in case maintenance of a primary well is required or additional capacity is needed to satisfy performance requirements.

MOTOR STARTER CONTROL:

- Each well motor start switch is a three position toggle switch; **HAND**, **OF**F, and **AUTO** and is located on the respective starter compartment on the Motor Control Center (MCC).
    - Select **HAND –** to energize motor
    - Select **OFF –** to stop motor
    - Select **AUTO –** for potential future automation
- Each motor starter control contains a green, red and amber light with a **PUSH TO TEST LAMP** feature.
    - Red indicates motor is **RUNNING**
    - Green indicates motor is **STOPPED**
    - Amber indicates **ALARM** condition
- If motor has shut down because of an alarm condition, press **ALARM RESET** before restarting the motor.

SEQUENCE OF OPERATION:

*Startup Procedure*

1. Inspect electrical equipment, plumbing, and controls for signs of hazards or damage.
2. Start primary production wells PW 7 and PW 8, or backup wells as appropriate.
3. Start focused extraction wells FE-02 and FE-03.
4. Adjust the flow rate from the FE well pumps as described in Operation Procedure OP-05.
5. Adjust production well back-pressure to 55 pounds per square inch (psi) at each operating PW well. (Backpressure may be reduced in order to keep capacity at a minimum of 600 gpm per well)
6. Record start-up date and time in the operation log, in the adjustments sections.
7. Weekly, record flow rates, total flows, pressures, hour meter readings and depth to water in the FE wells on the *FE/PWO Operation Log*.
8. If an FE flow meter is reading "0", record the flow and the number of hours it was reading zero (flow meter screen will alternate between "0" flow and the number of hours since zero flow began) on the *FE/PWO Operation Log* and follow Maintenance Procedure MP-03.

*Shutdown Procedure*

1. Record current operating data in the operating log prior to shutdown.
2. Inspect energized equipment, plumbing, and controls for signs of hazards or damage.
3. Shut off focused extraction wells (FE-02 and FE-03).
4. Shut off primary production wells PW 7 and PW 8, or backup wells as appropriate.
5. Verify that all PW and FE well motors are de-energized.
6. Lockout, tag and try activation of all PW and FE well motors before conducting maintenance activities.
7. Record shutdown date, time, and purpose, in the operating log, in the adjustment section.

# FE/PWO System Operation Procedure OP-02

| | |
|---|---|
| Procedure No. | OP-02 |
| Procedure: | Sample Sink/Sample Discharge Return Pump Procedures |
| Min. Frequency | Upon Occurrence |
| Original Date: | June 26, 2006 |
| Revision Date: | None |
| Updates: | None |

OPERATING PARAMETERS:

- The Sample Discharge Return Pump (SDRP-1) returns water from the sink to the system discharge piping.
- SDRP-1 is an Osmonics Tonkaflo SS Series Pump.
- SDRP-1 can be operated in the manual or automatic mode using the three position selector switch located adjacent to the sink in Bldg 70.
- In the automatic mode the sink level is controlled by two liquid level switches.
    - The high level switch opens solenoid valve SV-1 in the pump discharge line and energizes SDRP-1 when wet.
    - The low level switch closes solenoid valve SV-1 and deenergizes SDRP-1 when dry.
    - A third level switch in the sink (high high level) controls solenoid valve SV-2 and is discussed further in Operation Procedure OP-03.
- The sink is used for the collection and discharge of sample water from the system and purge water from the monitoring wells, as allowed under the facilities NPDES permit.
- Water discharged from the sink is normally returned to the system discharge piping ahead of the NPDES sampling port. However, to facilitate draining the system piping in Bldg 70, the discharge from SDRP-1 may be routed to the downstream side of the 12" gate valve (See: Maintenance Procedure MP-01).
- A 3-way ball valve is provided on the inlet of SDRP-1 to allow an alternate inlet source to SDRP-1 (See: Maintenance Procedure MP-01- System Piping in Building 70, Evacuation/Line Breaking).

MOTOR STARTER CONTROL:

- SDPR-1 motor start switch is a three position toggle switch; **HAND**, **OFF,** and **AUTO** and is located adjacent to the sink in Bldg 70.
    - Select **HAND** – to energize motor (Handle is spring loaded to return to OFF
    - Select **OFF** – to stop motor
    - Select **AUTO** – for automatic operation, allowing the sink level switches to control the pump motor

- The motor starter control contains a green, red and amber light with a **PUSH TO TEST LAMP** feature.
    - Red indicates motor is **RUNNING**
    - Green indicates motor is **STOPPE**D
    - Amber indicates **ALARM** condition
- If motor has shut down because of an alarm condition, press **ALARM RESET** before restarting the motor

SEQUENCE OF OPERATION:

1. Turn 3-way ball valve handle to the point toward the 2″ sink drain pipe.
2. Open 1″ ball valve discharging into 2″ discharge line from the focused extraction wells.
3. Close 1″ ball valve discharging into 12″ discharge line downstream of 12″ gate valve.
4. For manual operation: Turn selector switch to **HAND**. Spring return will return selector to OFF when handle is released.
5. For normal operation: Set selector switch to **AUTO.** The switch should be left in the auto position.
6. With a soft brush, gently clean the three sink basin level switches including the moving joints.

# FE/PWO System Operation Procedure OP-03

| | |
|---|---|
| Procedure No. | OP-03 |
| Procedure: | NPDES Sampling Procedures |
| Min. Frequency | Upon Occurrence |
| Original Date: | June 28, 2006 |
| Revision Date: | None |
| Updates: | None |

OPERATING PARAMETERS:

- Samples are to be collected for chemical analysis as required by the facility's National Pollutant Discharge Elimination System (NPDES) permit and the Final Record of Decision (ROD).
- Samples are collected from the sample line which runs from the discharge pipe of the combined FE/PWO streams (NPDES discharge) to a sink in Building 70.
- Grab samples can be collected at that sink using the manual gate valve.
- Flow proportional composite samples are collected using an ISCO 3700 Refrigerated Automatic Samplers, which draws a sample from a sample vessel that is fed by the sample line.
- The sample line feeds the sample vessel continuously when solenoid valve, SV-2 is programmed to be open. The sample vessel overflows into the sink were the sample discharge return pump (SDRP-1) pumps the water back into the NPDES discharge line. (See: Operation Procedure OP-02)
- SV-2 must be programmed to be open to coincide with the sampling event programmed for the ISCO composite sampler.
- See the *Wastewater Quality Assurance Manual* and *ISCO 3700 Portable Sampler Instruction Manual* for instructions on the operation, maintenance and programming of the composite sampler.
- Programming SV-2 to open is accomplished via the programmable logic controller panel view interface (Allen-Bradley PanelView 300 Micro) as described below.
- The panel view interface on the MCC has three main timer screens; two screens for setting values and a third screen for monitoring both timers.
    1. SET SAMPLE TIME TO START
    2. SET SAMPLE FLOW DURATION
    3. TIME UNTIL START
    4. TIME LEFT ON SAMPLE
- SV-2 is also controlled by the high-high level switch in the sink. SV-2 will close if the high-high level switch is wet, but will reopen if programmed to be open and the high level switch is dry. If the high-high level switch in the sink is wet, a message **SINK HIGH HIGH LIMIT – LEFT ARROW** will show on all timer screens until manually reset.
- SV-2 should be programmed to open in advance of the ISCO sampler starting time, to purge water from the line and should continue to be open for a sufficient

period of time to insure collection of the 24-hour composite sample. (i.e., SV-2 Open ½ hour before ISCO compositor starts and continue open for 25 ½ hours)

SEQUENCE OF OPERATION:

*Startup Procedure*

1. Turn 3-way ball valve handle to the point toward the 2″ sink drain pipe.
2. Open 1″ ball valve where SDRP-1 discharge line enters the 2″ line from focused extraction wells.
3. Close 1″ ball valve where SDRP-1 discharge line enters the 12″ NPDES discharge line.
4. With a soft brush, gently clean the three sink basin level switches including the moving joints.
5. Place SDRP-1 control switch (located adjacent to the sink) in the AUTO position.
6. Flush the Y-strainer immediately upstream of SV-2 by opening the blow down valve and discharging any collected solids into the sink.

*Programming SV-2 to open (Sample Water to Start Flowing)*

1. Program the ISCO sampler to collect a composite sample on a convenient date consistent with NPDES permit requirements. (See *Wastewater Quality Assurance Manual* and *ISCO 3700 Portable Sampler Instruction Manual* for instructions on the operation and programming of the composite sampler)
2. Program SV-2 using the panel view.
3. Set the starting time to open SV-2.
    a. Toggle to the screen titled, **SET SAMPLE TIME TO START**
        i. Press △ or ▽ to toggles through all screens
        ii. Or Press ▷ to toggles through the three timer screens only
    b. Select hours
        i. Press **F2** and then Press ↵
        ii. Or Press △ or ▽ until the cursor is just to the left of hours and then Press ↵
    c. Set hours value on sub screen
        i. Select numerical position
            1. Press ◁ or ▷
        ii. Select numerical value for each position
            1. Press △ or ▽
        iii. Press ↵ after all values are entered
    d. Select minutes
        i. Press **F3** and then Press ↵
        ii. Or Press △ or ▽ until the cursor is just to the left of minutes and then Press ↵
    e. Set minutes value on sub screen
        i. Select numerical position
            1. Press ◁ or ▷
        ii. Select numerical value for each position
            1. Press △ or ▽

iii. Press ↵ after all values are entered. (Note: You cannot set minutes to 0. If you attempt to set minutes at 0, the program will use the previous minutes setting)

4. Set the duration time for SV-2 to be open.
   a. Once an acceptable duration time as been established, the duration timer should not have to be reset
   b. Toggle to the screen titled, **SET SAMPLE FLOW DURATION**
      i. Press △ or ▽ to toggles through all screens
      ii. Or Press ▷ to toggles through the three timer screens only
   c. Select hours
      i. Press **F2** and then Press ↵
      ii. Or Press △ or ▽ until the cursor is just to the left of hours and then Press ↵
   d. Set hours value on sub screen
      i. Select numerical position
         1. Press ◁ or ▷
      ii. Select numerical value for each position
         1. Press △ or ▽
      iii. Press ↵ after all values are entered
   e. Select minutes
      i. Press F3 and then Press ↵
      ii. Or Press △ or ▽ until the cursor is just to the left of minutes and then Press ↵
   f. Set minutes value on sub screen
      i. Select numerical position
         1. Press ◁ or ▷
      ii. Select numerical value for each position
         1. Press △ or ▽
         2. Press ↵ after all values are entered
5. Toggle to the screen titled, **SAMPLE TIME UNTIL START - TIME LEFT ON SAMPLE**
   a. Press △ or ▽ to toggles through all screens
   b. Or Press ▷ to toggles through the three timer screens only
6. Start sample cycle
   a. Press **F1**,
      i. A seconds timer will show on the screen and **SAMPLE TIME UNTIL START** and T**IME LEFT ON SAMPLE** will show time remaining on their respective timers as time elapses
      ii. All timer screens will show the message C**OUNTING DOWN TO SAMPLE TIME** until SV-2 open, then the message will change to **SAMPLE FLOW ON**
      iii. When the cycle is complete, **SAMPLE TIME UNTIL START** and **TIME LEFT ON SAMPLE** will reset to their previous value and all timer screens will show the message **SAMPLE CYCLE OFF**.

*Other Related Panel View Procedures*

1. To stop sample cycle before it is complete
   a. Press **F4**
   b. All timer screens will show the message **SAMPLE CYCLE OFF**
2. If the high-high level switch in the sink is wetted, a message **SINK HIGH HIGH LIMIT – LEFT ARROW** will show on all timer screens until manually reset
   a. To manually reset, Press ◁

# FE/PWO System Operation Procedure OP-04

| | |
|---|---|
| Procedure No. | OP-04 |
| Procedure: | Routine Operating Tasks |
| Min. Frequency | Weekly |
| Original Date: | September 22, 2006 |
| Revision Date: | None |
| Updates: | None |

OPERATING ROUTINES:

1. Check for alarms and general equipment conditions for indications of maintenance needs.
2. Rotate standby pumps by briefly starting and stopping the motor.
3. During cold weather, check for tripped GFCI breakers (5) on the heat trace system and correct as necessary.
4. During cold weather, check for proper operation of the heat trace system by inspecting indicator lights (8 locations). Indicator light and heart trace should be on at approximately 40 degrees.
5. Measure the depth to water in the focused extraction wells. See Inspection Procedure IP-01.
6. Inspect the production wells for excessive packing leakage.
7. Record required data and completion of the above routine operating procedures on the FE/PWO Operation Log and report any maintenance requirement.

# FE/PWO System Operation Procedure OP-05

| | |
|---|---|
| Procedure No. | OP-05 |
| Procedure: | Flow Adjustment of Focused Extraction Wells and Pumps |
| Min. Frequency | Upon Occurrence |
| Original Date: | June 27, 2006 |
| Revision Date: | None |
| Updates: | None |

OPERATING PARAMETERS:

- The Focused Extraction Well Pumps should be operated such that the capture and containment of the contaminated groundwater plume is maximized.
- The system should also be operated such that the discharge limits established for the NPDES permit and the final Record of Decision (ROD) are not exceeded.
- To achieve these performance requirements, the system was designed for two Focused Extraction (FE) wells to pump at 20 gpm each.
- The FE well construction consists of a filter packed well screen in the targeted water-bearing zone. Aquifer tests indicate the pumps can be run full open.
- Operating experience has shown that build up of scale and slime can result in plugged well screens, pumps and piping resulting in reduced yields/flows.
- The flow from the FE well pumps should be controlled to prevent exposing the top of the well screen.
- Inspection of the water level in the well is covered by Inspection Procedure IP-01
- This operation procedure is intended to be used if the results of inspection procedure IP-01 indicate the water level is below the well screen or the FE well is pumping below the design flow of 20 gpm.
- Additional troubleshooting procedures for the FE pumps are available in the Goulds Pumps 4" Submersible Pumps Installation and Maintenance Manual on page 20.

MOTOR STARTER CONTROL:

- Each well motor start switch is a three position toggle switch; **HAND, OFF,** and **AUTO** and is located on the respective starter compartment on the Motor Control Center (MCC).
    - Select **HAND –** to energize motor
    - Select **OFF –** to stop motor
    - Select **AUTO –** for potential future automation

- The motor starter control contains a green, red and amber light with a **PUSH TO TEST LAMP** feature.
    - Red indicates motor is **RUNNING**
    - Green indicates motor is **STOPPED**
    - Amber indicates **ALARM** condition
- If motor has shut down because of an alarm condition, press **ALARM RESET** before restarting the motor.

ADJUSTMENT PROCEDURE:

*Groundwater Level Elevation is Below the Top Elevation of the Well Screen*

If the groundwater level elevation is below the top elevation of the well screen the flow rate from the extraction well must be reduced. This is best done by throttling back the FE flow rate. Step-by-step procedures include:

1. During pump operation, slowly close the discharge valve(s) until the flow from the FE well measures 20 gpm. Do not exceed 150 psi pressure at the pump discharge or the pressure relief valve will open and discharge water back into the well.
2. Measure the groundwater elevation and determine if the water level is a minimum of 1 foot above the top of the screen (See Inspection Procedure IP-01 for details). If the groundwater elevation does not meet exceed the minimum 1 foot above screen criteria, the well may require rehabilitation. Reduce pump flow as much as possible without causing the pressure relief valve to open and schedule maintenance as soon as possible. Continuing to operate the pump with the water level below the screen can exacerbate plugging or damage to the screen. Continuing to operate at less than 20 gpm may not provide sufficient groundwater capture.
3. If, after reducing the flow to 20 gpm, the groundwater elevation is significantly above the top to the well screen, the flow rate may be increased to optimize groundwater capture.
4. Slowly open the discharge valve(s) until the steady-state elevation is a minimum of 1 foot above the top of the well screen.
5. Record the final steady-state depth to groundwater, well flow rate, and pressure.

*The FE pump is operating below the minimum flow rate (20 gpm)*

1. Verify that the pump is on at the MCC and that all discharge line valves in Bldg 70 are fully opened.
2. Pump operation should also be confirmed by observing the pressure and flow at the pump.
3. If the pump is not pumping, the pressure gauge may still show system pressure but no flow will be observed. Negative flow may be observed if the line check valve (if so equipped) and the pump's internal check valve fail. Negative flow may also be observed if the sample line is opened and the line check valve only (if so equipped) fails.
4. If the pump is operational, measure the depth to water in the well. (See Inspection Procedure IP-01 for details)
5. Operating experience has shown that build up of scale and slime can result in plugging the pump discharge valve if the valve has been throttled back to reduce flow as described in the first procedure above. Attempt to open the pump discharge valves. If this successfully increases the flow rate, thoroughly exercise the valve to break up and clear the scale.
6. If the water level is significantly above the top of the well screen, slowly open the discharge valves and continue to measure the water level in the well. Maintain the steady-state water level a minimum of 1 foot above the top of the well screen.

7. If pump discharge is already fully opened or further opening is unsuccessful at increasing flow, measure the depth to water in the well, record the information. If the depth to water in the well is above the top of the pump, then at a minimum, pump repair is indicated. If the depth to water is below the top of the screen then well rehabilitation may also be required.
8. Measure the depth to water in a nearby monitoring well and compare it to the water level in the FE well to further ascertain the condition of the FE well. A high differential compared to the start up condition is an indication the FE well requires rehabilitation.
9. After repair/replacement of the pump only, without rehabilitation of the well, exercise caution when restarting the pump. Be aware that the well may also need maintenance. If the well screen is plugged the pump may be quickly starved for water. Throttle back the pump and measure the depth to water and follow the steps 2 thru 5 under the section, *Groundwater Level Elevation is Below the Top Elevation of the Well Screen,* and determine if additional well maintenance is required.

# Appendix C – Inspection Procedures

# FE/PWO System Inspection Procedure IP-01

| | |
|---|---|
| Procedure No. | IP-01 |
| Procedure: | Focused Extraction Well Inspection |
| Min. Frequency | Weekly |
| Original Date: | June 27, 2006 |
| Revision Date: | None |
| Updates: | None |

INSPECTION PARAMETERS:

- The focused extraction (FE) wells require routine inspection approximately every week.
- Water levels within the FE wells must remain above the top elevation of the well screen.
- The FE well pumps must be positioned within the well sump below the well screen, and a minimum pump flow rate of 20 gpm must be maintained for optimal FE well operation.
- Detailed pump operating and maintenance procedures are available in the *Goulds Pumps 4" Submersible Pumps Installation and Operation Instructions.*
- Detailed start up procedures for the FE pumps are found in Operation Procedure OP-01

INSPECTION POINTS:

1. Identify if the area around the wellhead is clear of debris and heavy over-growth.
2. Visually inspect the FE wellhead and associated piping and wiring for obvious damage or maintenance needs (i.e. corrosion, breakage, etc).
3. Inspect the heat trace system and the pressure relief valve according to the FE/PWO Routine Inspection and Maintenance Schedule/Log
4. Measure the depth to water within each FE well during pump operation via the drop tube access on top of the well seal. Record the depth to water on FE/PWO Operation Log and compare the measured value to the depth to the top of the well screen in the table below and determine if the groundwater level is a minimum of 1 foot above the top of the well screen.

| Critical Pump/Well Measurements (Feet) | FE 02 | FE 03 |
|---|---|---|
| Depth to Top of Well Screen* | 38.18 | 37.22 |
| Max Desired Depth to Water* | 37.18 | 36.22 |
| Elevation to Top of Well Screen** | -5.90 | -6.90 |
| Min Desired Elevation to Water** | -4.90 | -5.90 |
| Depth to Top of Pump* | | 50.01 |
| Depth to Bottom of Pump* | | 53.47 |
| Depth to Bottom of Well* | 58.18 | 57.22 |

*Depth to top of well screen, water and top and bottom of pump are measured from the top of the well casing
**Elevation datum is NGVD

5. Record the flow rate and pressure at which the pump is currently operating.
6. If FE well and assembly is not operating correctly as described, refer to Operation Procedure OP-05.
7. Record and report all inspection observations and any maintenance needs on the FE/PWO Operation Log.

# Appendix D – Maintenance Procedures

# FE/PWO System Maintenance Procedure MP-01

| | |
|---|---|
| Procedure No. | MP-01 |
| Procedure: | System Piping in Building 70, Evacuation/Line Breaking |
| Min. Frequency | Upon Occurrence |
| Original Date: | June 27, 2006 |
| Revision Date: | None |
| Updates: | None |

PURPOSE:

In the event that system piping in Building 70 must be drained for maintenance purposes such as maintenance of the MAGFLO flow meter, or the double check valves, the following procedure should be used to drain the piping using the Sample Discharge Return Pump (SDRP-1) and minimize spills.

MOTOR STARTER CONTROL:

- Each well motor start switch is a three position toggle switch; **HAND, OFF,** and **AUTO** and is located on the respective starter compartment on the Motor Control Center (MCC).
    - Select **HAND –** to energize motor
    - Select **OFF –** to stop motor
    - Select **AUTO –** for potential future automation

- The SDPR-1 motor start switch is a three position toggle switch; **HAND**, **OFF,** and **AUTO** and is located adjacent to the sink in Building 70.
    - Select **HAND –** to energize motor (Handle is spring loaded to return to OFF)
    - Select **OFF –** to stop motor
    - Select **AUTO –** for automatic operation, allowing the sink level switches to control the pump motor

- The motor starter control contains a green, red and amber light with a **PUSH TO TEST LAMP** feature.
    - Red indicates motor is **RUNNING**
    - Green indicates motor is **STOPPED**
    - Amber indicates **ALARM** condition
- If motor has shut down because of an alarm condition, press **ALARM RESET** before restarting the motor.

SEQUENCE OF OPERATION:

1. De-energize all production wells and focused extraction well motors.

2. Lockout; tag and try activation of all production wells and focused extraction well motors.
3. Close the 12″ gate valve on the 12″ system discharge piping.
4. Open the 1″ ball valve in the SDRP-1 discharge line where it discharges into the 12″ system discharge piping, immediately downstream of the 12″ gate valve.
5. Close the 1″ ball valve discharging into the 2″ discharge line from the focused extraction wells.
6. Connect a 1″ hose from the drain line under the 12″ discharge pipe, to the 3-way ball valve on the inlet of SDRP-1.
7. Turn the 3-way ball valve handle to point toward the hose connection.
8. Open the 1″ drain valve under the 12″ discharge pipe near doorway.
9. Energize SDRP-1 using selector switch adjacent to the sink – Turn the handle to **HAND** position and hold.
10. Run SDRP-1 until the piping is drained. **DO NOT** run the SDRP-1 without water.

# FE/PWO System Maintenance Procedure MP-02

| | |
|---|---|
| Procedure No. | MP-02 |
| Procedure: | Focused Extraction Well Pump System, Isolation/Line Breaking |
| Min. Frequency | As Required |
| Original Date: | September 28, 2006 |
| Revision Date: | None |
| Updates: | None |

PURPOSE:

- Operating experience has shown that scale periodically builds up in the focused extraction wells screen, well pumps, and discharge piping and component parts.
- Scale also builds up on the throttle/isolation valves, which require maintenance in order to gain complete shut off of the valve to isolate the affected piping system.
- Following are the recommended procedures to isolate the focused extraction (FE) well pump FE 03 to facilitate pump removal, or to clean the flow totalizer or other component parts.
- **Note:** The FE 02 discharge piping contains a second in line check valve between the flow totalizer and the pump. If this check valve is functioning, line pressure will still be trapped between the throttle/shut off valve and the check valve if using the procedure for FE 03.
- Use the Alternate Procedure to isolate FE 02 or to isolate the entire FE discharge system from both pumps up to the 2" double check valve in Bldg 70.

MOTOR STARTER CONTROL:

- Each well motor start switch is a three position toggle switch; **HAND, OFF,** and **AUTO** and is located on the respective starter compartment on the Motor Control Center (MCC).
    - Select **HAND –** to energize motor
    - Select **OFF –** to stop motor
    - Select **AUTO –** for potential future automation

- The motor starter control contains a green, red and amber light with a **PUSH TO TEST LAMP** feature.
    - Red indicates motor is **RUNNING**
    - Green indicates motor is **STOPPED**
    - Amber indicates **ALARM** condition
- If motor has shut down because of an alarm condition, press **ALARM RESET** before restarting the motor.

SEQUENCE OF OPERATION:

*Isolate Flow Totalizer and/or Focused Extraction Well Pump FE 03*

1. Before de-energizing the focused extraction (FE) well pump, open and close the throttle/shut off valve down stream of the flow totalizer several times to break up and loosen any scale that may have built up on the seats of the valve. As the valve is closed, backpressure will increase and flow will be reduced but the flow velocity across the seating surfaces of the valve will increase and help to flush the scale from the valve seats. When the pressure increases to 150 psi, the pressure relief valve will open and water will be discharge back into the well. The relief valve is capable of handling the full flow from the pump. However, it is not recommended that this condition be allowed to continue for an extended period of time since the back pressure will immediately drop and cause the pressure relief valve to close, allowing the back pressure to build and the pressure relief valve to reopen again, rapidly cycling and causing undue wear and tear on the pressure relief valve and the pump.
2. Open the throttle/shut off valve until the pump is de-energized.
3. Stop and de-energize well pump FE 03, lockout, tag and try.
4. Close the throttle/shut off valve down stream of the FE 03 well pump and flow totalizer.
5. Open the sample line valve to relieve the pressure between the pump and the throttle/shut off valve. [Note: The pump is equipped with an internal check valve, which will otherwise result in trapping pressure between the pump and the throttle/shut off valve.]
6. Observe the pump side pressure gauge to confirm that pressure has been relieved from the piping between the pump and the throttle shut off valve. If not repeat step 1 and 5 without re-energizing the pump, until the discharge pressure and flow from sample line are zero. If pressure and flow from the sample line are still not at zero follow the alternate procedure below. [Note: FE 02 discharge piping contains a second in line check valve between the flow totalizer and the pump. If this check valve is functioning, line pressure will be trapped between the throttle/shut off valve and the check valve. This will require the alternate procedures to safely isolate FE 02 well pump or remove the flow totalizer from the FE 02 piping system.]

*Alternate Procedure: Isolate Flow Totalizer and/or Focused Extraction Well Pump FE 02 and/or FE 03*

1. Stop and de-energize FE 02 and FE 03. Lockout, tag, and try.
2. Close the downstream ball valve on the 2"double check valves in Bldg 70.
3. Open the 1" ball valve in the SDRP-1 discharge line where it discharges into the 12" system discharge piping, immediately downstream of the 12" gate valve.
4. Close the 1" ball valve discharging into the 2" discharge line from the focused extraction wells.
5. Connect tubing to test port 1 (upstream end) on the 2" double check valve and run the tubing to the sample sink.

6. Place the SDRP-1 control in the AUTO position. See Operation Procedure OP 2.
7. Open test port 1 on the 2″ double check valve and discharge the water into the sink. SDRP-1 will be controlled by the level switches in the sink and will discharge the water downstream of the 2″ double check valve.
8. Open the sample line on the FE 02 and FE 03 system piping.
9. These procedures should result in relieving the pressure from all FE discharge piping. Open the sample line at FE 02 to relief the pressure between the FE 02 well pump and the second in line check valve.
10. Observe the FE system discharge piping and confirm that the pressure in the section of line to be opened is in fact reduced to zero.
11. It is now safe to break the line to the pump or to remove the flow totalizer for cleaning.
12. If one of the two FE well pumps is expected to be out of service for an extended period of time and the throttle/shut off valve will not fully close the line should be capped to allow start-up of the other FE well pump.

# FE/PWO System Maintenance Procedure MP-03

| | |
|---|---|
| Procedure No. | MP-03 |
| Procedure: | Cleaning Focused Extraction Well Flow Totalizer |
| Min. Frequency | As Required |
| Original Date: | September 28, 2006 |
| Revision Date: | None |
| Updates: | None |

PURPOSE:

- A Signet 8150 battery powered flow totalizer provides the measure of flow rate and total flow from each of the focus extraction well pumps.
- This flow totalizer is a paddle wheel type recorder.
- Operating experience has shown that scale periodically builds up on the paddle wheel and piping enough to stop operation of the flow totalizer and indicate zero flow.
- Scale also builds up on the throttle/isolation valves, which require maintenance in order to gain complete shut off of the valve and isolate the affected piping system.
- Following is a procedure for determining if the flow meter is plugged and the steps necessary to clean the flow meter.

SEQUENCE OF OPERATION:

*Determine If Flow Meter Is Plugged*

1. If the FE flow meter is indicating zero flow, slowly close the throttle valve downstream of the flow meter.
2. Observe for increased pressure at the pump discharge pressure gauge and listen for increased noise coming from the throttle valve.
3. If pressure and noise increase and the flow meter remains at zero the meter is likely plugged. Follow the steps below to clean the meter.
4. If the pressure does not increase above line pressure, verify that the pump is on.
5. If the pump is on but not able to exceed line pressure then repair/replacement of the pump is indicated.

*Clean FE Flow Meter*

1. Complete the Focused Extraction Well Pump System Line Breaking Procedure MP-02.
2. Carefully unscrew the sensor cap, mounting the flow totalizer to the system piping. **Caution:** If pressure still exists in the pipeline, the flow totalizer may rapidly jump out of the pipe when the connection is fully broken. **Stand to the side.**
3. Remove the totalizer with a firm but gentle lifting and rotating motion.

4. Remove the paddle wheel and pin from the sensor tube by gently prying with a screwdriver between the sensor tube tab and the paddle wheel until the pin is free. (See manufacturer's instructions)
5. Clean all scale buildup from the paddle wheel, pin and sensor tube.
6. Clean all scale buildup inside the pipe adapter fitting.
7. Lubricate the paddle wheel, pin, sensor tube and adapter fitting with a light film of silicon lubricant.
8. Reassemble flow totalizer and install in the pipe adapter using a firm but gentle rotating motion in the same orientation as when removed, with the paddle wheel perpendicular to the flow. (See manufacturer's instruction for further details)
9. Close sample line valves.
10. Open throttle/shut off valves.
11. Re-energize FE well pumps.
12. Record this activity on the *FE/PWO System Maintenance Log.*
13. Record the activity and the flow rate, pressure and depth to water on the *FE/PWO Operations Log* in the adjustment section.

# Appendix E – Operation/Inspection/Maintenance Logs and Schedules - Forms

## Routine Inspection and Maintenance Schedule/Log

Month _____ Year _____

*Date and inititial in the space provided when inspection or maintenance task is complete*

| Unit | Item | Routine Inspection Frequency | Suggested Routine Inspection Points | Routine Inspection Date Completed | Routine Maintenance Frequency | Suggested Routine Maintenance | Routine Maintenance Date Completed | Notes: |
|---|---|---|---|---|---|---|---|---|
| Allen-Bradley PanelView 300 Micro Interface / MicroLogix 1500 Programmable Controller | System Operation | Monthly | Check that system operation is normal by toggling through display screens | | As necessary | Troubleshoot system operation problems | | |
| Allen-Bradley MicroLogix 1500 Programmable Controller | Errors/Faults | Monthly | Inspect program controller for error/faults. An error exist if all indicator LED's are off, the POWER and FAULT are solid, or the POWER LED is solid and FAULT LED is flashing. | | As necessary | Troubleshoot errors. | | |
| Building 70 | First Aid Kit | Monthly | First Aid Kit is located in designated area, is fully stocked, and is in good condition. | | As necessary | Restock first aid kit. | | |
| Building 70 | General Building Condition | Monthly | Inspect for general building condition including: poor exterior paint, roof leaks, unacceptable building temperatures, structural integrity, cracks in walls or foundation, foundation settling, insect/rodent problems, etc. | | As necessary | Promptly troubleshoot and repair Building 70 problems as encountered. | | |
| Building 70 | Vegetation/Weeds | Monthly | Keep the building vicinity clear of excessive vegetation/weeds that may create hazards or problems. | | Annually | Spraying herbacide on vegetation surrounding building. | | |
| Building 70 | Forced Air Heater | Semiannual | Producing heat, turning on as designed, and is clean. | | Annually | Clean heating element and heater cabinet. Troubleshoot operation. | | |
| Building 70 | Building Lighting | Monthly | Lamps functioning properly | | As necessary | Replace lamp bulbs (48" Type 32W T8). | | |
| Building 70 | Fire Extinguisher | Monthly | Fire extinguisher is located in designated area, is full, and certification is current. Also, date and initial the inspection tag | | As necessary | Replace, refill, and/or re-certify. | | |
| Building 70 | Eye Wash Station | Monthly | Inspect that eye wash station is clear of obstructions, is clean, and operational. Check that wash fluid is current | | Semi Annually | Clear obstructions, clean, test operation and drain old fluid. Replace wash fluid and date the tag | | |
| Building 70 | Building Door and Lock | Monthly | Building door is in good condition, paint is not pealing/flaking, and opens easily. Lock is lubricated, undamaged, free of corrosion, and operational. | | As necessary | Repair door, hinges, and/or locking latches. Repaint door as needed. Replace or lubricate lock as necessary. | | Deleete |
| System Piping | FE Pump Pressure Relief Valve | Annually | Test pressure relief valve to 150 psi tp confirm operation. | | As necessary | Repair/Replace as necessary | | |
| MAGFLO 5100W Flow Sensor/Transmitter | Error/Status Log | Monthly | Check for errors (indicated by blinking triangle on transmitter display) Check error types (per section 8.7.2 in Sitrans F M Magflo Handbook) | | As necessary | Address errors and/or clear log | | |
| Motor Control Center | Motor Indicator Lights | Monthly | Indicator light function (Push To Test). Clean exterior of MCC and Panel | | Every 2-4 years | Replace indicator lights. | | |
| Osmonic Tonkaflo SS Series Pumps (SDRP-1) | Motor | Monthly | Check that motor cooling air passages are not blocked | | As necessary | Clear cooling air passages | | Added |
| Osmonic Tonkaflo SS Series Pumps (SDRP-1) | Mechanical Seals | Monthly | Check for excessive leakage | | As necessary | Replace Mechanical Seal | | |
| Substation | 500 KVA Transformer | Monthly | Inspect for oil leaks. Inspect containment for presence of oil | | As necessary | Repair leaks, remove excess oil from containment | | Added |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Substation | Yard | Monthly | Inspect for presence of vegetation | | Annually | Spraying herbacide on vegetation inside and surrounding substation yard | | Added |
| System Piping | Ashcroft Pressure Gauges | Monthly | Inspect for: Erratic or random pointer motion. Readings that are suspect (especially when the true pressure is 0 psig). Broken windows. Leakage of gauge fill. Any signs of service media leakage through the gauge. Discoloration of gauge fill that impedes readability. | | As necessary | Replace, repair, or calibrated pressure gauges. | | |
| System Piping | Double Check Valves | Annually | Test for proper operation in accordance with the manufacturers written procedures | | As necessary | Service/Repair as needed | | |
| Overall System | Access | | | | Annually | Spray herbicide and clear/cut vegetation as necessary to allow access to all well pumps and monitorings wells | | |
| System Piping | Discharge Pipe/Outfall | Semiannual | Inspect above-ground discharge pipe and outfall for damage, corrosion, or otherwise repair needs. | | As necessary | Repair as necessary. | | |
| PW Wells Pumps/Motors | General Condition | Monthly | Check for excess vibration of the pump | | As necessary | Troubleshoot and rebuild as necessary | | |
| PW Wells Pumps/Motors | Pump Foundation | Semiannual | Check pump foundation for settling. | | As necessary | Troubleshoot any pump foundation settling. | | |
| PW Wells Motors | Motor Insulation | Annually | Megger motor winding insulations | | As necessary | Rewind/Rebuild motor | | |
| PW Wells Motors | Motor Bearings | Monthly | Check lubrication level and add oil as necessary. Use Mobile DTE 26 or equivalent | | Annually | Change oil in motor bearing Use Mobile DTE 26 or equivalent | | |
| PW Wells 3 and 7, Motors | Upper Motor Bearings | | | | Annually | Grease bearing annually for continuous service. Grease bearing once per 3 years for reduced service. Use, Chevron SR 2 or equivalent | | |
| PW Wells Pumps/Motors | Pump Packing | Monthly | Inspect pump packing for excessive leaking. | | As necessary | Add grease, adjust packing gland or replace packing as necessary | | |
| PW Wells Pumps/Motors | Pump and Motor Exterior Cleaning | Monthly | Check for exterior cleanilness of pump and motor and that motor cooling air passages are not blocked | | Monthly | Clean oil and dirt from the pump and motor exterior and clear cooling air passages | | |
| PW Wells Pumps/Motors | Pump Performance | Annually | Measure total dynamic head and flow. Take power readings. | | As necessary | Repair/Replace if capacity drops below 600 gpm | | |
| Signet 8150 Flow Totalizers | Battery Replacement | Monthly | Low battery indicator is displayed. | | Every 4 years | Replace Lithium batteries per section 5 of Signet 8150 Flow Totalizer User's Manual | | |
| Tyco Thermal Controls Heat Tracing System | General System | | | | Annually | Perform conmissioning test as detailed in Raychem Industrial Heat-Tracing Installation and Maintenance Manual sections 8 -10 | | |
| Yokagawa mR1000 Recorder | Chart Paper | Monthly | Check if paper supply sufficient until next scheduled change ( 744 cm required for 31 days at chart speed of 10mm/hr ) | | BiMonthly | Refill chart paper per 3.2 of Yokogawa mR10000 Recorder User's Manual | | |
| Yokagawa mR1000 Recorder | Felt Pen or Plotter Pens | Monthly | Check if recorded lines and printed characters are clear | | As necessary | Replace felt pen or plotter pens per 3.3 of Yokogawa mR10000 Recorder User's Manual | | |
| Yokagawa mR1000 Recorder | Recorder Cleanliness | Monthly | Clean exterior of recorder | | Annually | Clean Recorder per 11.2 of Yokogawa mR10000 Recorder User's Manual | | |
| Yokagawa mR1000 Recorder | Internal Light LED | Monthly | Check that LED brightness still sufficient or LED has not burned out. | | Every 2 years | Replace LED light per 11.3 of Yokogawa mR10000 Recorder User's Manual (2 years = half life of brightness at default setting) | | |
| Yokagawa mR1000 Recorder | Display | Monthly | Display is clean, bright, and operating correctly. | | Every 5 years | Replace display (5 years = half life of brightness at default setting) | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Yokagawa mR1000 Recorder | Chart Paper Feed Motor | Monthly | Operating correctly. | | Every 5 years | Replace chart paper feed motor | | |
| Yokagawa mR1000 Recorder | Plotter Carriage | Monthly | Operating correctly. | | Every 5 years | Replace plotter carriage | | |
| Yokagawa mR1000 Recorder | Recorder Motor | Monthly | Operating correctly. | | Every 5 years | Replace motor | | |
| Yokagawa mR1000 Recorder | Lever Bearing | Monthly | Operating correctly. | | Every 5 years | Replace lever bearing | | |
| Yokagawa mR1000 Recorder | Pen Servo | Monthly | Operating correctly. | | Every 5 years | Replace pen servo | | |
| Yokagawa mR1000 Recorder | Recorder Calibration | Monthly | Measurement accuracy has declined. Compare to Siemens Mag 5000 Flow Transmitter | | Annually | Recalibrate recorder per 11.4 of Yokogawa mR10000 Recorder User's Manual | | |
| Yokagawa mR1000 Recorder | Pen Position | Monthly | Recording is inaccurate. | | Annually | Adjust pen position per 11.5 of Yokogawa mR10000 Recorder User's Manual | | |

Notes:

# Appendix F – Operation Logs - Data

## FE/PWO Operation Log

**Month/Year:** _____ **Observer:** _____

| | | Focused Extraction Well 2 | | | | | Focused Extraction Well 3 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Time | Flow Rate (GPM) | Total Flow (1000 Gallons) | Pressure (PSI) | Depth to water* (Ft) | Hour Meter | Flow Rate (GPM) | Total Flow (1000 Gallons) | Pressure (PSI) | Depth to Water** (Ft) | Hour Meter |
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| | | Production Well 3 | | Production Well 5 | | Production Well 7 | | Production Well 8 | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Time | Pressure (PSI) | Hour Meter | Pressure (PSI) | Hour Meter | Pressure (PSI) | Hour Meter | Pressure (PSI) | Hour Meter |
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| | | Combined Flow | | | Routines | | | Adjustments |
|---|---|---|---|---|---|---|---|---|
| Date | Time | Flow Rate (GPM) | Total Flow (Million Gallons) | Pressure (PSI) | Rotate SB Pumps | ✔ HT GFCI Breakers | ✔ HT Function | Operational Adjustment |
| | | | | | | | | |
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* Depth to Top of Screen FE 02 = 38.18 ft
** Depth to Top of Screen FE 03 = 37.22 ft

**Notes:** _____

# Appendix G – Maintenance Logs – Data

**FE/PWO System Maintenance Log**

| Date | Action | Equipment | | | | | | | | | | Initials |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | FE-02 | FE-03 | PW-3 | PW- 5 | PW-7 | PW-8 | SDRP | PLC | NPDES | Misc | |
| 7/5/2006 | **EXAMPLE** - Sensor Failed. Cleaned scale buildup off flow sensor paddle wheel and piping and coated with silicone grease. | | X | | | | | | | | | S.S. |
| | | | | | | | | | | | | |
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# Operations Plan—Focused Extraction/Production Well Optimization System for the RMC-Troutdale Facility

Technical Memorandum GW No. 33

**Reynolds Metals Company**

**TROUTDALE FACILITY**

**CH2MHILL**

August 2005

PDX/052350019.DOC

# Operations Plan—Focused Extraction/Production Well Optimization System for the RMC-Troutdale Facility

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DATE: August 24, 2005

PROJECT NUMBER: 166034.07.09.06

## 1.0 Introduction

The Reynolds Metals Company (RMC) facility in Troutdale, Oregon, is the site of a former aluminum reduction plant that has ceased operation and has been demolished. The facility was added to the U.S. Environmental Protection Agency's (EPA) National Priorities List in December 1994 based on soil and groundwater contamination.

On September 30, 2002, EPA Region 10 issued a *Record of Decision for Interim Remedial Action* (Interim ROD) (EPA, 2002) to address groundwater contamination at the east potliner and scrap yard areas. The selected remedy required the installation of a focused extraction and production well optimization (FE/PWO) system to contain and remove groundwater containing high levels of fluoride. The system is currently under construction and is expected to be ready for operation in September 2005. This operations plan outlines procedures to operate the FE/PWO system.

## 2.0 Purpose and Objectives

This operations plan outlines the configuration, monitoring, and reporting requirements for the FE/PWO system operation. This plan is to be used in conjunction with *Memorandum WP No. 69: Focused Extraction and Production Well Optimization System Startup Performance Monitoring Plan* (CH2M HILL, August 2005) and *Memorandum WP No. 68: Sitewide Groundwater Monitoring Plan (2006 through 2010) at RMC-Troutdale* (CH2M HILL, July 2005) to meet the requirements of the *Unilateral Administrative Order for Remedial Design and Remedial Action* (RD/RA UAO) *Scope of Work for Reynolds Metals Superfund Site, Attachment 2* (EPA, August 2005).

This plan is organized into four sections:

- Introduction
- Purpose and Objectives

- Operations
- Schedule of Operations

Project-specific objectives for the FE/PWO system include the following:

- Flow and drawdown from the FE wells are sufficient to capture and remove groundwater with high levels of fluoride in the Upper Gray Sand (UGS) zone in the vicinity of the scrap yard and east potliner areas.
- Flow and drawdown from the production wells are sufficient to provide hydraulic containment of fluoride plumes in the South Plant area.
- Combined FE/PWO discharge to the Columbia River meets existing facility National Pollutant Discharge Elimination System (NPDES) permit levels.
- Operation and maintenance of the system will continue for a minimum of 5 years.

# 3.0 Operations

This section describes activities that must be accomplished for proper operation of the FE/PWO system.

## 3.1 System Configuration and Flow Path

Figure 1 schematically illustrates the location of focused extraction, production, and monitoring wells; piping sizes; and general system layout. Figures 2, 3, and 4 provide typical pipe size, and valve, meter, and gauge locations at each production well, focused extraction well, and inside Building 70.

During system operation, groundwater is removed through a combination of shallow focused extraction wells (FE02 and FE03) and a minimum of two of four deep production wells (PW03, PW05, PW07, and PW08). As shown in Figure 2, water from the focused extraction wells flows through a 4-inch-diameter underground pipe to Building 70, where it is mixed with water from the production wells. As shown in Figure 3, water from the production wells flows through an 8- and 10-inch-diameter underground pipe to Building 70 prior to mixing. The combined flow from the FE/PWO system (Figure 4) is discharged to a 12-inch-diameter underground pipe that connects to an existing 16-inch-diameter underground pipe located adjacent to Sundial Road. The 16-inch-diameter underground pipe (Figure 1) discharges to the Columbia River under an existing NPDES Permit (Oregon Permit # 100757, EPA Permit # OR-0000060).

## 3.2 System Startup and Operation

FE/PWO startup procedures have been developed to meet the following objectives:

- Optimize fluoride mass removal from the UGS zone
- Optimize hydraulic containment of the existing fluoride plume in the South Plant area
- Meet existing plant NPDES permit requirements prior to discharge to the Columbia River

- Protect equipment from damage
- Ensure operator safety
- Document system removal and containment efficiencies

### 3.2.1 Initial Startup and Performance Monitoring Phase

Initial startup and performance monitoring will include a combination of 2-hour step-rate tests, a 1-week baseline water level monitoring test, and constant-rate pumping tests as described in *Memorandum WP No. 69* (CH2M HILL, August 2005).

Groundwater level, pumping rate, and water quality information will be generated during this phase of the program to establish daily removal rates and system removal/containment efficiencies during the first stages of startup.

### 3.2.2 Discharge Monitoring

Water quality sampling requirements for FE/PWO system discharge will be performed as required in the existing facility NPDES Permit. Additionally, the fluoride discharge limit from the combined FE/PWO system will be less than 5 milligrams per liter (mg/L). FE/PWO system discharge sampling will occur at Outfall 001 prior to discharge to the Columbia River.

Additional sampling of individual system components may occur as needed during initial system startup and optimization or in the future to monitor system performance.

### 3.2.3 Long-Term Water Quality

All water quality monitoring for FE/PWO performance will be implemented as described in *Memorandum WP No. 68* (CH2M HILL, July 2005). This monitoring will be performed for 5 years and includes measuring groundwater levels, fluoride concentrations, and cyanide concentrations at the FE wells, production wells, and surrounding wells at the Alcoa site. No additional water quality measurements are required in this operations plan; however, periodic sampling of individual system components may occur as needed.

### 3.2.4 System Optimization

The system will be operated to optimize its performance in meeting the project objectives identified in Section 2.0. Optimization is obtained primarily by adjusting the pumping rate of the production and FE wells to maximize removal and containment of fluoride in the aquifer. FE/PWO performance monitoring and long-term groundwater monitoring will provide the basis for recommending operational changes to optimize performance. Long-term groundwater monitoring is described in *Memorandum WP No. 68* (CH2M HILL, July 2005). Operational changes to the system will be communicated to EPA and the Oregon Department of Environmental Quality (DEQ) and documented in the annual groundwater report.

### 3.2.5 System Safeguards

The FE/PWO system includes an interlock to prevent the FE wells from operating if the production wells are not operational. A programmable logic controller for the FE/PWO

system will not allow an FE well pump to start unless at least one production well is operating.

### 3.2.6 Day-to-Day Operations

The following section describes the day-to-day operation of the system. The frequency of monitoring may be adjusted to more frequent (for example, daily) or infrequent (for example, monthly) as the project proceeds based on performance of the system.

The process monitoring is as follows:

1. Once a week, an inspection of the FE/PWO system will be conducted. The weekly inspection should include the following:
    - Proper functioning of instrument system (meters, alarm systems, etc.)
    - Integrity of process lines
    - Flow rate, total flow, pressure, and pumping time at each operational FE well and adjustment of flow rates, if necessary, to meet target
    - Pressure and pumping time at each operational production well to verify instrument readings and adjustment of flow rates, if necessary, to meet target
    - Flow rate and total flow for combined flow of all operational wells to verify instrument readings and adjustment of flow rates and pressure, if necessary, to meet target
2. Collection of water quality samples at the frequency specified in *Memorandum WP No. 68* (CH2M HILL, July 2005)— that is, quarterly, semiannually, or annually depending on the well and year. The sitewide activity will include sampling of the FE wells, production wells, and all other sitewide wells
3. NPDES monitoring as prescribed in the waste discharge permit
4. Monthly visual inspection of valves and pressure gauges
5. Documentation of all inspections, process control activities or measurements performed, and system adjustments made in an operations logbook

## 3.3 Recordkeeping

The process for recordkeeping in the operational logbook for the FE/PWO system is as follows:

1. The following inspection data will be recorded:
    - Recording date and time
    - Condition of equipment
    - Modifications made to system
    - Flow rate, total flow, and pressure at operational FE wells
    - Pressure at operational production wells
    - Pumping time at operational wells

- Combined flow rate and total flow for all wells
- Adjustments to system operation
- Final flow rate and pressure following any adjustments

2. The following water quality data will be recorded:

- Recording date and time
- Fluoride concentration
- Flow rate or pressure when sample collected
- Combined flow rate for all wells
- List of other samples collected

This information will be used to prepare the annual report as specified in *Memorandum WP No. 68* (CH2M HILL, July 2005).

## 3.4 Reporting

The RD/RA UAO requires that certain information be reported to EPA and DEQ. Specifically, Task 3: Groundwater FE/PWO System Operation and Monitoring Plan in the RD/RA UAO states that the operations plan shall address the effectiveness of mass removal in reducing fluoride contamination in groundwater, fluoride capture and mass removal, intermediate and deep zone water quality performance in meeting maximum contaminant levels (MCLs), and compliance with discharge limits. Table 1 summarizes the reporting requirements in the RD/RA UAO for this operations plan, identifies the document that addresses the requirement, and identifies the reporting frequency to EPA and DEQ.

**Table 1**
**Summary of Evaluation and Reporting Requirements for FE/PWO System Operations and Monitoring Plan**

| Criterion | Demonstration | Document | Frequency of Reporting to Agencies |
|---|---|---|---|
| 1. Mass removal in reducing fluoride concentrations | Short term: Fluoride concentration in FE/PWO area | *Memorandum WP No. 69*[a] | End of performance period (estimated February 2006) |
| | Long term: Fluoride concentration sitewide and in areas of interest | *Memorandum WP No. 68*[b] | Annually |
| 2. Fluoride capture and mass removal | Short term: Fluoride concentrations and hydrographs in FE/PWO area. Fluoride mass removed in FE wells | *Memorandum WP No. 69*[a] | End of performance period (estimated February 2006) |
| | Long term: Fluoride concentration sitewide and in areas of interest, water level contour maps and hydrographs | *Memorandum WP No. 68*[b] | Annually |
| 3. Intermediate and deep zone water quality performance in meeting MCL | Mean fluoride concentration in intermediate and deep zones compared with the MCL | *Memorandum WP No. 68*[b] | Annually |

**Table 1**
**Summary of Evaluation and Reporting Requirements for FE/PWO System Operations and Monitoring Plan**

| Criterion | Demonstration | Document | Frequency of Reporting to Agencies |
|---|---|---|---|
| 4. Compliance with discharge limits | NPDES monitoring at outfall | NPDES Permit[c] | Monthly |
| 5. Evaluation of system performance and provisions for adjustments to the system | Short term: Flow rate and fluoride concentration in FE wells and FE concentrations in performance monitoring network | *Memorandum WP No. 69*[a] | End of performance period (estimated February 2006) |
| | Long term: Fluoride concentration, mass removal at FE wells, and fluoride capture | *Technical Memorandum GW No. 33*[d] | Annually |

[a] *Memorandum WP No. 69: Focused Extraction and Production Well Optimization System Startup Performance Monitoring Plan* (CH2M HILL, August 2005).

[b] *Memorandum WP No. 68: Sitewide Groundwater Monitoring Plan (2006 Through 2010) at RMC-Troutdale* (CH2M HILL, July 2005).

[c] *National Pollutant Discharge Elimination System Waste Discharge Permit for Reynolds Metals Company, Troutdale, Oregon* (DEQ, January 2003).

[d] *Technical Memorandum GW No. 33: Operations Plan—Focused Extraction/Production Well Optimization System for the RMC-Troutdale Facility* (CH2M HILL, August 2005).

Mass of fluoride removed will be calculated for each FE well by multiplying total flow times the average fluoride concentration during the period of operation. If fluoride concentrations significantly decrease over the time period, then an incremental method to determine mass may be used.

# 4.0 Schedule of Operations

The system is considered operational after the constant-rate test is performed. The following operation and monitoring schedule is proposed:

| Task | Date (2005) |
|---|---|
| FE/PWO System Initial Startup and Shutdown | September |
| PW Operation | October |
| FE/PWO System Operation | November |
| Aquifer Testing/Performance Monitoring | December through January |
| **Task** | **Date (2006 through 2010)** |
| System Inspection and Monitoring | Weekly |
| 1st Quarter Sitewide Water Quality Sampling Event | February |
| 2nd Quarter Sitewide Water Quality Sampling Event | May |
| 3rd Quarter Sitewide Water Quality Sampling Event | August |
| 4th Quarter Sitewide Water Quality Sampling Event | November |

The FE/PWO system is expected to be ready for operation in September, at which time the system will be started to inspect all components and make sure the system is operating according to specifications. The system will then be shut down until the performance monitoring can be performed (after Company Lake is dewatered and the production wells have been pumping for 4 to 6 weeks). The system will operate for a minimum of 5 years.

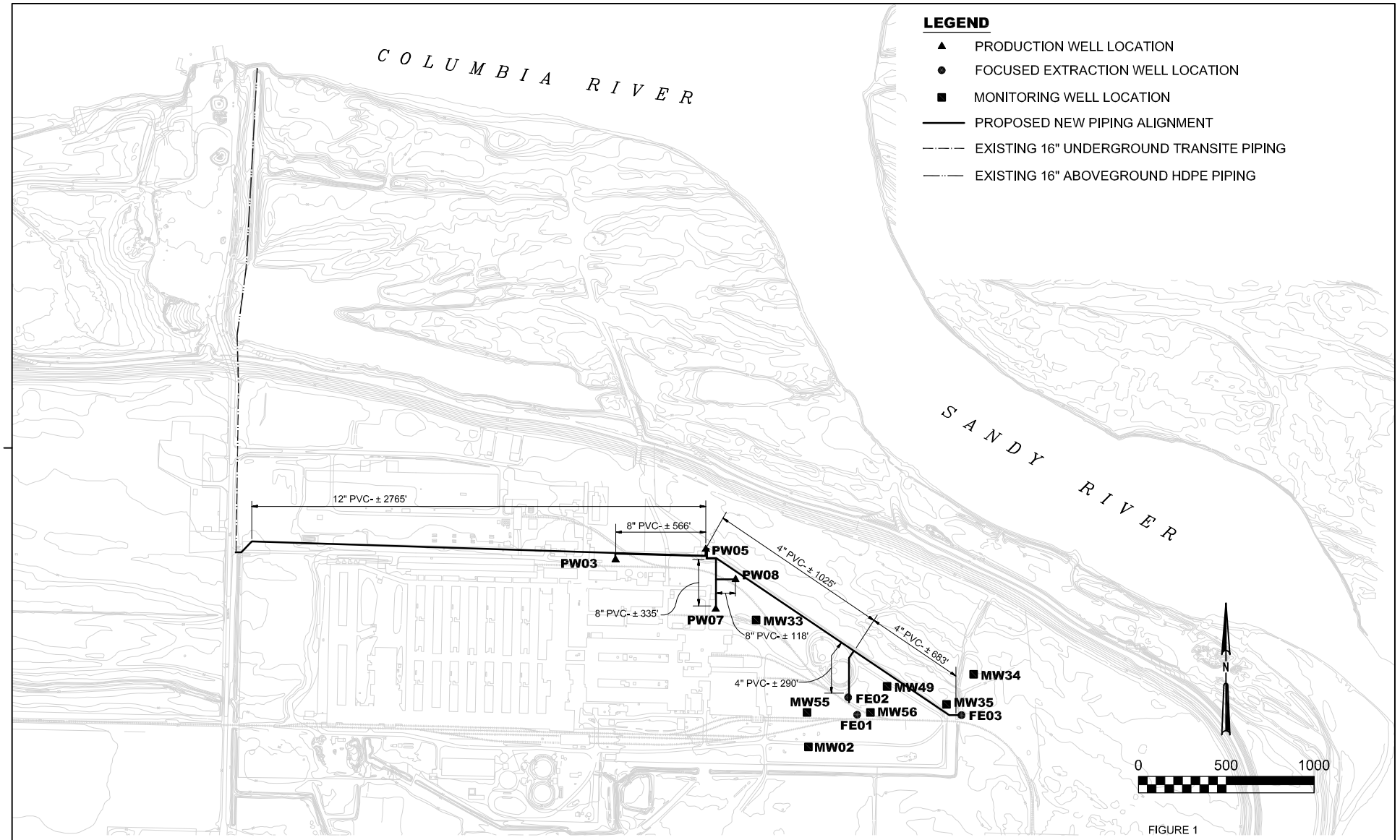
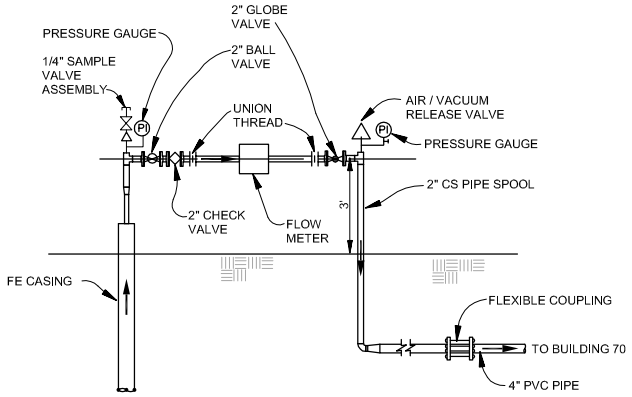



FIGURE 1
FE/PWO SYSTEM OPERATIONS PLAN
SYSTEM LAYOUT

CH2MHILL

PLOT DATE: 08-Aug-2005 FILENAME: \\Rosa\proj\ALCOA\166034\CAD\JAN05NEW\166034_Figure 1.dwg



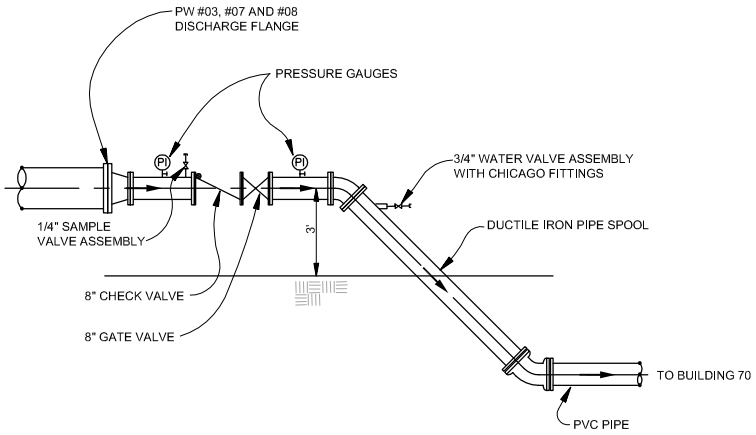

**LEGEND**

← WATER FLOW PATH

FIGURE 2
FE/PWO SYSTEM OPERATIONS PLAN
TYPICAL FE WELL CONFIGURATION

CH2MHILL

PLOT DATE: 08-Aug-2005 FILENAME: \\Rosa\proj\ALCOA\166034\CAD\JAN05NEW\166034_Figure 2.dwg



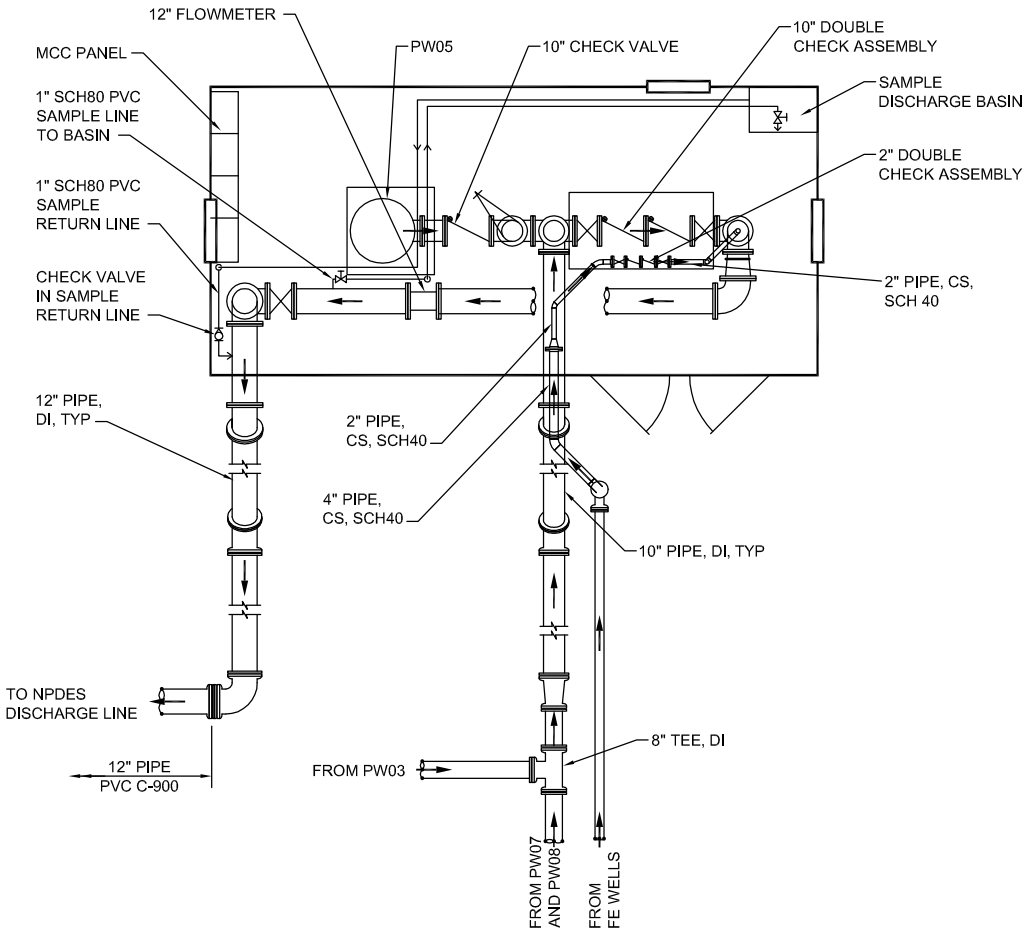

**LEGEND**

← WATER FLOW PATH

FIGURE 3
FE/PWO SYSTEM OPERATIONS PLAN
TYPICAL PW CONFIGURATION

CH2MHILL

PLOT DATE: 08-Aug-2005 FILENAME: \\Rosa\proj\ALCOA\166034\CAD\JAN05NEW\166034_Figure 3.dwg




**LEGEND**

← WATER FLOW PATH

**BLDG 70 PIPING LAYOUT**

FIGURE 4
FE/PWO SYSTEM OPERATION PLAN
BUILDING 70 PIPING LAYOUT

CH2MHILL

PLOT DATE: 08-Aug-2005 FILENAME: \\Rosa\proj\ALCOA\166034\CAD\JAN05NEW\166034_Figure 4.dwg